The FOUNDRY

Volume 57
Number 4

Published
Semimonthly

CLEVELAND, OHIO, FEBRUARY 15, 1929

Castings Support the Staff as Old Glory Waves

FROM early biblical times, when standards designated the different tribes in the desert camp of the Israelites, flags have been used to convey definite information of various kinds. Through the many periods of history, when nation after nation captured a

Cast Iron Bases Are Used for the Support of Flag Poles in Many Cities

position of dominance in the civilized world, the flag was the national emblem. Suspended from a standard, the flag or emblem was carried in battle by the men of Alexander, Caesar, Napoleon, Nelson, Pershing and the thousands of other military leaders whose success or failure has done so much to shape the destinies of the human race. Perhaps the first use of the fixed standard, or flag pole, for displaying the flag was found at the large castles which covered Europe in mediaeval times. In the early days of the American Republic, a high mast from an old sailing vessel usually was erected at a prominent place in the thriving Atlantic seaboard villages. Towns in the interior boasted of a flag pole cut from the tallest tree in the surrounding forest. In recent years, the steel flag pole has taken the place of the wooden mast or pole, to the benefit of the foundry industry, for the bases of these poles usually are heavy iron castings.

Find Where Castings Can Be Sold.

CONTENTS

FEATURE ARTICLES

Page

Produces Chair Castings in Large Quantities—By Frank G. Steinebach 140

Core Tests Show Peculiar Results—By George J. Corrigan 144

Melting Steel in the High Frequency Furnace—I—By Heinz Neuhauss 146

British Firm Anneals Cast Iron 151

Bill Anchors a Pipe in a Casting—By Pat Dwyer 154

Program Nears Completion 157

Charging Air by Weight—By H. V. Crawford 159

Melting Iron in the Cupola—Part XII—By J. E. Hurst 164

Raised Near a Blast Furnace He Knows His Irons 171

REGULAR DEPARTMENTS

How and Why in Brass Founding — By Charles Vickers 163

Queries on Foundry Practice 168

The Shakeout 172

Trade Trends in Tabloid 173

Comings and Goings of Foundrymen 174

What the Foundries Are Doing 177

New Trade Publications 178

—⊡—

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO ..... 1147 Peoples Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2203-2206 No. 220 Broadway
PITTSBURGH ..... 2148-49 Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1653 Pennsylvania Avenue
BIRMINGHAM, ENGLAND ..... Prince's Chambers
LONDON, ENGLAND ..... 416-417 Caxton House, Westminster, S. W. 1
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Wilhelmstrasse 114, Berlin S. W. 48

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified paid subscribers, and honest advertising of dependable products

Copyright 1929 by the Penton Publishing Co.

Produces Chair Castings in Large Quantities

By Frank G. Steinebach

TRENDS toward exquisite beauty in the design and construction of modern theaters and auditoriums have resulted in marked changes in interior appointments. Decorations and all equipment are designed carefully to blend into a harmonious setting for the performance on the stage or the silver screen. From the spectacular and gorgeous playhouse on Broadway to the less pretentious movie on Main street, beauty and comfort govern choices of design.

The opera chair is one of the important pieces of equipment in the theater. Practically all of the better chairs produced today are constructed with cast iron standards. This is true especially in the highest grade of equipment where it is necessary to secure artistic effects which cannot be obtained by other methods. To a greater or less degree, the middle standards of the seats have been standardized, but great individuality is expressed in the design of the seat end standards.

The American Seating Co., Grand Rapids, Mich., manufacturer of theater chairs, school desks, ecclesiastical furniture, lodge furniture, etc., maintains a large gray iron foundry at its plant in the Furniture City, where castings for its products are poured. Since the company is one of the largest producers of theater chairs in the country, and the requirements on the foundry are heavy, a description of the equipment used and the practice followed should be of interest.

The melting, molding and coremaking departments of the foundry are located in one main building, 150 feet wide and 226 feet long. Cores are made in a small room at one end of the building and the foundry office is at the opposite end. Two cupolas are located along one side of the building about midway between the foundry office and the core department. These cupolas are charged by mechanical equipment which extends to the storage yard along the side

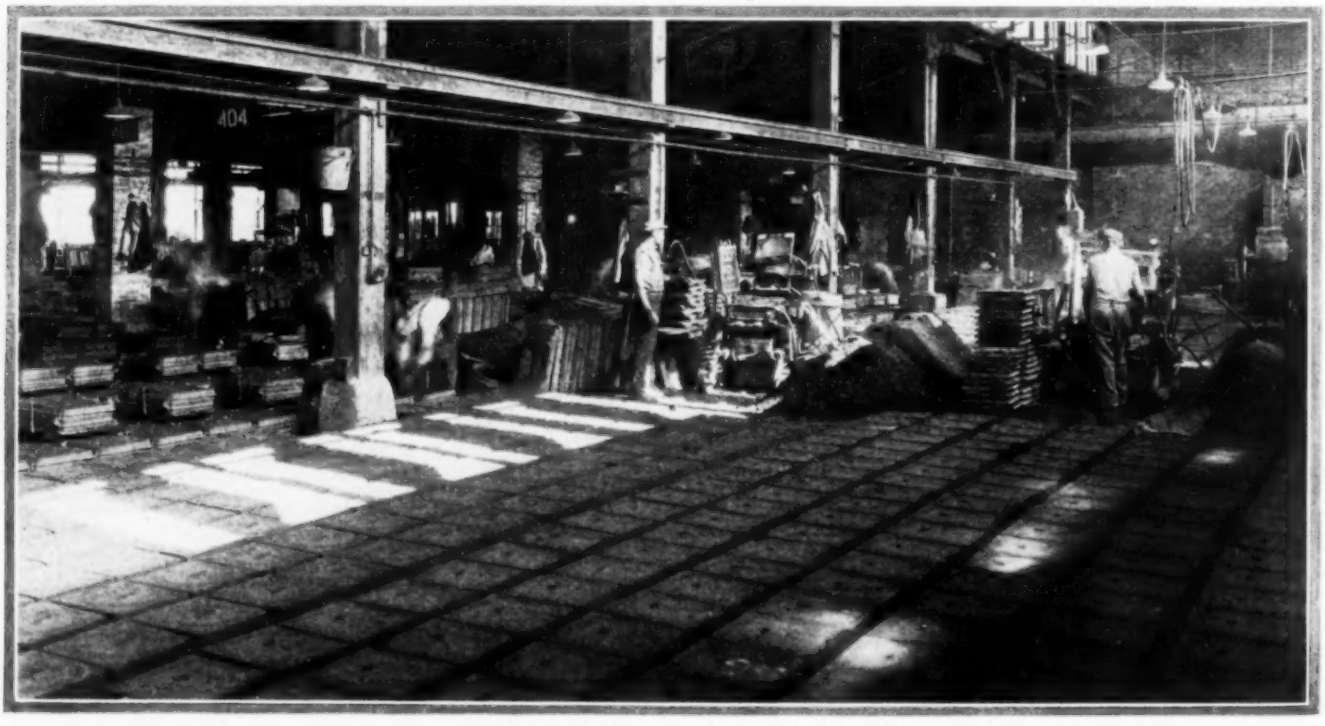


Fig. 1—View of One part of the Foundry Showing a Machine Floor and a Hand Floor

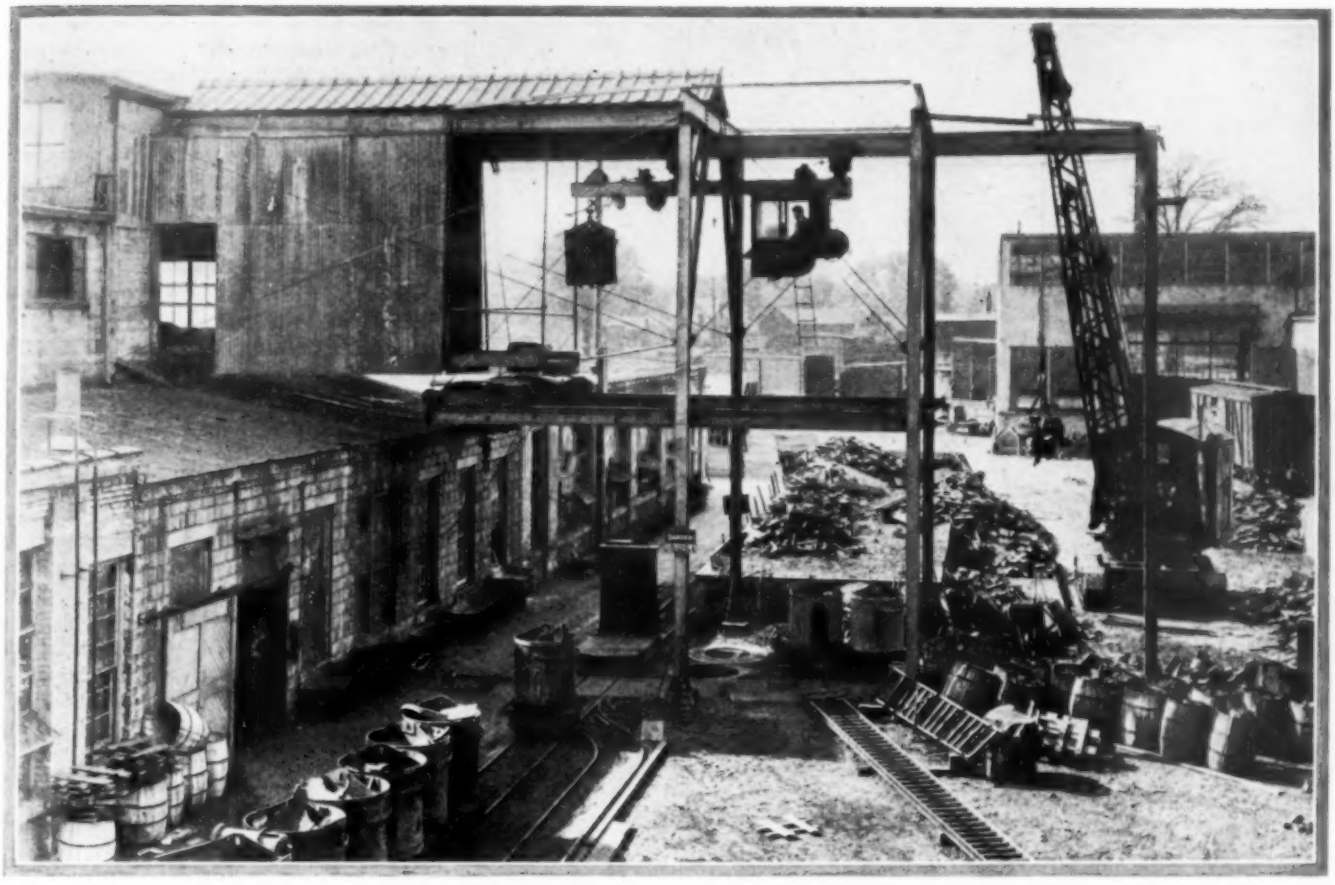


Fig. 2—Pig Iron and Coke Are Received in Railway Cars and Handled Mechanically into the Cupola

of the building. With exception of the space occupied by the cupolas, core department and the office, the entire floor space is used for molding.

Molds are made on the floor, at benches and on machines. Thirty-five hand floors, 7 hand bench floors and 13 machine floors are provided. The hand floors produce castings for middle and end standards for theater seats and miscellaneous work. Practically all of the floor work is made in hinged flasks, either of wood or steel. The latter were made by the Sterling Wheelbarrow Co., Milwaukee. Patterns are mounted in an oil-sand followboard and have a draft in both directions from the parting line at the center. That type of parting permits the side lift which is necessary when using the hinged flask. A special asbestos parting is used on the lighter castings and plumbago is employed where castings have heavier sections.

End standards are made on the floor in hinged, steel flasks. The hinges were applied to the flasks by the American Seating Co. Usually the end standards are gated at the bottom of the lower cross piece between the two legs. However, some designs are so complicated that it is not possible to place the gate at the point mentioned. In that case, the gate is placed at the back of the standard, with three pencil gates leading to the mold. A hand floor, using the hinged steel flasks is shown in Fig. 1. With approximately 5500 molds made each day in the foundry, an exceptionally large floor space is required. However, the present building falls a little short of having sufficient space for the molds and a certain amount of stacking is required. Since the hand floors all use flasks, and all but two of the machines employ tapered flasks, the hand floors must do a part of the stacking. As may be noted at the left in Fig. 1 a row of molds is placed above two adjacent rows on the floor.

Several bench floors are used for small miscellaneous work or for short run jobs where the quantity required is not sufficient to justify the expense of making a pattern plate. Of the 13 molding machines used, 11 were rebuilt by the American Seating Co., and two were built by the Tabor Mfg. Co., Philadelphia. The rebuilt molding machines are used to make molds for small parts, brackets, seat arms, supports, etc. Patterns are mounted on a matchplate and a taper flask manufactured by the Hines Mfg. Co., Cleveland, is used.

The method employed to draw the pattern is interesting. The machine is provided with four lifting rods, two at each end of the flask, which are actuated by a hand lever. Each rod has two projections which engage the cope and the matchplate as the rods move up. On the left side, the

Fig. 3—Pig Iron Is Loaded From the Dock into the Charging Buckets

tops of the rods are made in the shape of a hinge, similar to those used on the flasks on the hand floors, and projections with hinges have been built to the taper flasks. After the mold is rammed by squeezing, the lever is pulled, causing the four rods to move up. The rods first come in contact with the cope, the two parts of the hinges engaging on one side. This carries the cope upward and draws that part of the mold away from the pattern plate. As the rods move upward and shortly after the cope has been drawn from the plate, the lugs on the rods catch under the plate and lift it away from the drag. The cope then is raised at the right side until it reaches the position shown at the machine on the right in Fig. 1 the weight being supported by the hinges. The plate is lifted off, the cope then lowered, with the aid of the hinge, until it is supported by the four rods. The cope then is lowered into place by a movement of the hand lever. This equipment has increased production and also eliminated considerable lifting by the machine operator.

Many of the middle standards for theater seats are made on the two machines made by the Tabor company. One standard is made to each mold. Steel flasks are used and the molds are stacked two high, as may be noted in the background of Fig. 5. The mold is gated at the bottom of the cross piece connecting the legs, and between the standards when two are provided in the flasks which are rammed on the hand floor.

Fig. 4—Coke Is Carried in Buckets to the Charging Floor

Two permanent mold casting machines, made by the Holley Permanent Mold Machine, Inc., Detroit, are used for casting certain types of desk bases and for experimental work. One of the machines, shown in Fig. 5, was being used to make a pedestal for a school desk at the time this article was prepared. This pedestal, shown in the foreground of Fig. 5, has a steel insert cast in the top. This insert is placed in the mold at the left before the mold is closed. When the machine is to be placed in operation, the two molds are heated by a gas flame until they reach a temperature of approximately 900 degrees Fahr.

After casting has started, the fan is turned on and the mold is cooled by the blast of air directed against the inside of the metal mold. Two vibrators are provided to assist in removing the casting from the mold. Lampblack, applied to the refractory surface of the mold before the metal is poured, also assists in removing the casting.

Since only an exceedingly small quantity of cores are required in the work produced, the coreroom is limited in size. Core sand is mixed and then riddled through a machine made by the Champion Foundry & Machine Co., Chicago. The cores are dried in a drawer type oven built by the Foundry Equipment Co., Cleveland.

Metal is melted in two cupolas built by the Whiting Corp., Harvey, Ill., and equipped with mechanical charging equipment. A general view of the equipment in the yard is shown in Fig. 2. Pig iron, coke and limestone are delivered to the foundry on the sidetrack from the Pere Marquette railroad, shown at the right of the illustration. Pig iron and scrap are unloaded by the crawler type crane equipped with an electric magnet. The coke is forked from the cars to avoid crushing and the limestone is unloaded by a bucket attached to the crane. Pig iron and scrap are placed in piles on the loading platform or dock, which is 16 x 75 feet or in piles at the side of the platform. The coke is piled along the sidetrack, as shown in Fig. 4. A supply of materials sufficient to last three weeks is kept in the yard at all times and during the winter months, a greater supply is maintained.

Charges are made up in buckets carried on an electrically-operated scale car which travels the length of the loading platform or dock. The car was built by the company maintenance department and the scale

was furnished by the Howe Scale Co., Rutland, Vt. A special counterweight and pulley device has been provided to eliminate the use of a trolley. A cable from the scale car is secured at one side of a hollow post built along the side of the building about midway between the two extremes of travel of the scale car. The opposite side of the post has a pulley over which the wire operates. A counterweight is provided between the pulley and the attached portion of the wire. When the scale car is directly opposite the post, the counterweight is near the bottom, and when the scale car reaches either extremity of the scale car track the counterbalance is near the top of the post.

Each charge weighs 2400 pounds and consists of 1500 pounds of pig iron, 350 pounds of commercial scrap and 550 pounds of returned scrap. Both high and low silicon iron are used. During the morning two men make up 18 charges in buckets. These buckets are transferred from the scale car to the small cars, shown in Fig. 2, and are moved to the storage track shown in the foreground. An electric hoist, supported on a trolley, is used to transfer the buckets from the scale car to the small industrial cars. When the unit first was installed, this crane was not provided and it was found necessary to keep an operator in the charging crane cab during the entire day. The trolley type electric hoist is operated by the men on the ground, and this eliminates the need for one man during the morning.

At one o'clock four men in the yard and two on the platform start to fill the cupolas. Twelve charges are necessary to fill both furnaces, 5 being placed in the small unit and 7 in the larger cupola. The melting ratio is 1 to 7 and 240 pounds of coke is placed between each charge. The blast is put on at 2:30 and the remaining operations are carried on with two men on the platform, two in the yard and two at the spout. During the morning, charges of coke are loaded in buckets as shown in Fig. 4, and are carried to the charging platform. When the cupolas are being filled, coke is brought from the storage pile in barrels over the roller conveyor and dumped into a charging bucket. For convenience in handling, the bucket is placed in the pit which may be noted at one side of the scale car in Fig. 2. However, when the blast is on, the coke is dumped into the cupola from the containers which previously were placed on the charging platform. The charging equipment and the trolley type crane were manufactured by the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.

Floor men catch their own metal from the cupola and carry it to their floors. However, the production on the machine floors is so large that the metal is carried to the various floors in bull ladles. The hand ladles are supported by trolleys carried on a monorail. Each machine operator pours off his own floor. Test bars are made of each heat and these are analyzed in an outside laboratory. Between 30 and 35 tons of iron is melted daily. The castings are shaken out by the night crew, loaded into steel boxes carried on trucks and taken to the cleaning department which is located in another building built at the end of the foundry. The sand is tempered and cut by the night crew with a sand cutting machine manufactured by the American Foundry Equipment Co., Mishawaka, Ind.

The cleaning department is equipped with 12 tumbling mills built by the Whiting Corp., Harvey, Ill., and one sandblast table manufactured by the American Foundry Equipment Co., Mishawaka, Ind. Standards are tumbled in one of eight square mills. The castings are packed in the mills with considerable care so that when the lid is clamped in place the castings will not move. Since all of the cleaning work is accomplished by the stars, a liberal supply is placed in the barrel with the castings. Each barrel is equipped with an individual drive with a start and stop button within easy reach of the operator. The square barrels are protected when in motion by a special guard. This guard consists of a series of wood strips fastened in a horizontal position on a strip of canvas. These sticks, held in place by the canvas, are supported by two pieces of angle iron built in a curved shape just beyond the circular path of the outer edge of the barrel.

Steel grit is used as the abrasive for the sandblast table. An interesting device has been installed to reclaim the steel grit which may be carried away with the dust removal system. This consists of a small magnetic separator located at the discharge end of the dust arrester. The separator was built by the Magnetic Mfg. Co., Milwaukee. All of the dust taken from the sandblast table must pass through the separator. Quite a saving of abrasive materials is effected in this way.

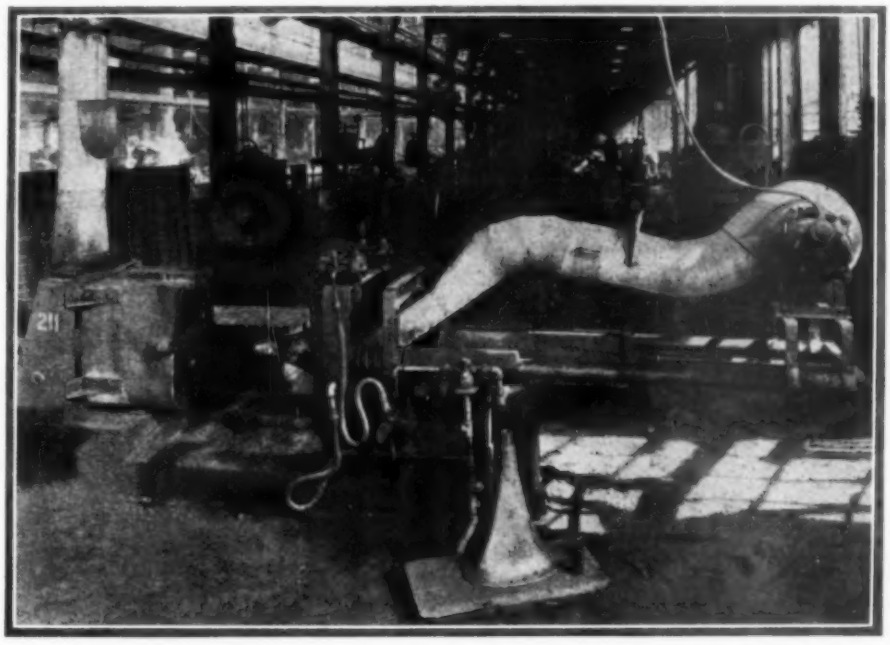


Fig. 5—Several Types of Castings Are Being Made on Permanent Mold Machines. Note the Casting in the Foreground

Issues Bulletin

A recent bulletin published by the department of engineering research, University of Michigan, Ann Arbor, Mich., presents results obtained in an investigation of the stability of metals at high temperatures. The work was conducted by C. L. Clark under the direction of and in collaboration with A. E. White. The bulletin is Engineering Research bulletin No. 11, and may be obtained from the department of engineering research, University of Michigan, Ann Arbor, Mich., for $1.

Core Tests Show Peculiar Results

A Series of Tests Designed To Approximate Actual Conditions, Indicated Among Other Features that Old Molding Sand Contains an Unknown Element that Saps Core Strength

By George J. Corrigan

SOME of the desirable features of ideal core binders might be listed as follows:

1—Should burn out and leave no ash. In other words, entire core binder should turn to gas when in contact with hot metal.

2—Should not be susceptible to overbaking or burning.

3—Should mix easily with core sand to form a homogeneous mixture.

4—Should leave the core box clean.

5—Should bake quickly and at as low a temperature as possible.

6—Should make a core waterproof to withstand storage in air and acidproof to stand storage in green sand molds.

7—Should bake without giving off offensive or inflammable gases.

8—Should make a sufficiently porous core to give ample ventilation.

9—Should be of nonedible matter to avoid attack by vermin.

10—Should be of such a nature as not to create a fire hazard.

11—Should make a core with high resistance to wash and pressure of molten metals.

12—Should make a core that will collapse at proper time, allowing for contraction of casting.

13—Should burn out in casting without giving off offensive gases.

This list could be continued indefinitely. Generally, cores are required which are sufficiently hard to avoid undue use of reinforcing rods and at the same time break down to be easily removed from the castings.

Tests of core binders published to date have all been on dry fresh baked cores. A core recently baked is an entirely different core from one that has been stored in air for two weeks or in a green sand mold for even a few hours. What should be known is—the condition of the core at the time the casting is poured. Previous conditions of cores are of no importance. It should also be known how the core acts when it comes in contact with the hot metal. Other tests show little of value to the man using the cores in the foundry.

With this thought in mind experiments were undertaken to determine the condition of cores at the time of pouring the casting. Results are shown in the accompanying table.

The Unknown Element

Most cores lose 60 per cent of their strength when buried in molding sand for 24 hours. In other words, a core that has remained over night in a mold is a far different core than that which is tested for strength in the laboratory. The molding sand (not new molding sand) contains a chemical agent which attacks the core much more rapidly than plain moisture.

A core that would stand submersion in water for 24 hours with little loss in strength, would lose 50 per cent of its strength when buried in old molding sand for a few hours. While cores stored in air for several days, or in molding sand a few hours, failed in strength tests, their appearance practically equaled a fresh baked core.

In an attempt to find what occurred when cores come in contact with hot metal, they were placed in an electric oven at 1300 degrees Fahr. Practically all commercial core oils including linseed, ignited in a few seconds and burned until decomposition was complete.

The core oils marked *A. L. R.* and *A. L. Pt.* were made in an attempt to overcome some of the faults of the more common commercial core oils. For most purposes they were slightly better and considerably more economical than the other oils tested.

The *no bake* core was made without baking of any kind. It is an air hardener, requiring 15 to 20 minutes to harden. Experiments with it are not yet complete, while, as shown in the table, it is low in strength yet it has been used successfully on some aluminum castings.

All the experiments are far from complete, owing to lack of time, although they were started nearly a year ago. The meager results are given here with the idea of injecting a new thought in core testing. The pulling and crushing of fresh baked dry cores in the laboratory are not a final indication of the success of a core as used in the foundry.

The tests made were under controllable conditions. All cores were baked in an electric oven pyrometrically controlled. Temperatures were started at 115 degrees Fahr. and brought up to 450 degrees Fahr. An electric oven was used as it was felt greater control could be obtained. Pyrometers were checked and not greater error than 5 degrees Fahr. obtained at any time.

A special core box was made to make standard samples with one-inch cross section and to fit the Henry L. Scott & Co., testing machine which was to be used. Several samples were used in each test. Crushing and other tests than tensile were made but as they always bore direct relation to tensile tests they were abandoned.

Where different core binders were used and a comparative test made all cores were baked simultaneously in the same oven.

Where the test was made in molding sand the samples were completely buried in sand. Warm sand as commonly used was taken from the production line of a nonferrous foundry. I feel

sure similar results would be obtained from cores buried in sand from an iron foundry. The sand was not over 115 degrees Fahr. and there were no effects from steam.

While the cores were completely buried I feel the same results would be obtained if only a portion was buried as when the core is set in a mold. I think the attack is from a gas in the molding sand although I am not sure. It is a well known fact that cores that remain in molds for periods of 24 hours lose a great deal of their strength.

The mixtures marked *A. L. R.* and *A. L. Pt.* were made primarily in an effort to find a core binder that would stand up under dampness. They are really waterproof cores, but they stand up in the molds little better than straight linseed though their waterproofness is much greater.

Need Further Tests

Strength tests of the *A. L. R.* and *A. L. Pt.* indicate a strength comparative to linseed but at a considerably reduced cost.

All tests were made in a nonferrous foundry and sand used was standard core sand for that purpose.

These tests are only indicative and far from complete but I would like to see some one who has time and facilities to push such tests further. The time honored strength tests of fresh baked cores are not satisfactory to the foundry foreman.

Testing cores in a condition similar to that in which they are when the molten metal strikes them, is needed rather than strength tests on fresh baked cores. Also, determinations should be made of what takes place in the breaking down of the core under the action of the molten metal.

Old molding sand contains an active chemical agent which rapidly destroys core strength, but this agent has not yet been isolated. It is not contained in new molding sand. Knowing this agent it might be possible to find a way to combat it. Otherwise the work is only a "cut and try affair."

There is also some possibility of making certain soft cores that require no baking.

I shall be glad to hear from or cooperate with anyone interested in making further tests along this line.

Mining Engineers Will Meet in New York

The American Institute of Mining and Metallurgical Engineers will hold its annual meeting in New York from Monday, Feb. 18 to Friday, Feb. 22. The iron and steel division will offer a program of five sessions, Feb. 18 and 20, meeting on the afternoon of the latter day with the coal and coal products division. John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., will deliver the Howe lecture on "Studies of Hadfield's Manganese Steel with the High Power Microscope" at 4 p.m., Monday.

The Institute of Metals dinner will be held at the Savoy Plaza hotel. A. J. Wadhams, International Nickel Co., New York, will speak on "Nickel and Its Alloys." Sessions for the discussion of papers will be held both before and after noon, Feb. 20. A comprehensive symposium on corrosion will be held Thursday, and the annual lecture will be presented at 4 p.m. by Dr. U. R. Evans, Cambridge, England. His topic will be "Passivity of Metals and Its Relations to the Problems of Corrosion." Papers of interest to foundrymen to be presented during the meeting are:

"Metallic Electrodes for Cast-Iron Arc Welding," by Shun-ichi Satoh, Tokyo, Japan; "Incipient Shrinkage in Some Nonferrous Alloys," by J. W. Bolton and S. A. Weigand; "Resistance of Copper-silicon-manganese Alloys to Corrosion by Acids," by A. H. Bedworth; "Inhibition of Corrosion of Aluminum by Soaps," by H. V. Churchill; "Resistance of Iron-nickel-chromium Alloys to Corrosion by Acid," by N. B. Pilling and D. E. Ackerman; "Some New Developments in Acid-resistant Alloys," by B. E. Field; "High Strength Brasses," by O. W. Ellis; and "Heat Treatment and Mechanical Properties of Some Copper-zinc and Copper-tin Alloys Containing Nickel and Silicon," by W. C. Ellis and H. Schumacher.

British Iron and Steel Institute To Meet

The annual meeting of the British Iron and Steel institute will be held May 2 and 3, 1929, at the Institute of Civil Engineers, London, S. W. 1. At this meeting Professor Henry Louis will assume office as the president. The autumn meeting will be held at Newcastle-upon-Tyne and will take place there the week commencing Monday, Sept. 9

The latest date for receiving applications from candidates for election at the annual meeting is March 11, and for the autumn meeting, July 31. Candidates for membership, pending their election, are entitled to attend meetings and receive papers. All papers offered to the institute for publication are submitted to a publication committee which reports to the council. Intending authors are desired to note that the following are the latest dates for receiving papers for either of the general meetings: for the annual meeting, Feb. 15, 1929, and for the autumn meeting, June 15, 1929.

Henry Bedinger Rust, president, Koppers Co., Pittsburgh, has been elected a director of the Westinghouse Electric & Mfg. Co., Pittsburgh.

Condition of Cores at Time of Pouring the Casting

Core binder		Tensile strength	Ignition and decomposition 1300° Fahr. Ignit. Hr.	Ignit. Min.	Decomp. Hr.	Decomp. Min.	Solubility in caustic soda solution. Per cent dissolved in time given 1 hr.	2 hr.	8 hr.	24 hr.	Loss strength after 2 wks. stor. in air. per cent	Loss strength after 24 hrs. in mldg. sand. per cent
A. L. R. oil	40:1	186	....	....	2	35	0	0	0	0	30	50
A. L. R. oil	60:1	126	....	....	2	35	0	0	0	0	30	50
A. L. R. oil	80:1	76	....	....	2	35	0	0	0	0	30	50
A. L. Pt. oil	40:1	162	....	....	2	50	0	0	0	0	30	50
A. L. Pt. oil	60:1	131	....	....	2	50	0	0	0	0	30	50
A. L. Pt. oil	80:1	83	....	....	2	50	0	0	0	0	30	50
Core oil	40:1	195	0	56	1	45	25	50	100	....	40	60
Core oil	60:1	121	0	24	2	50	25	50	100	....	40	60
Core oil	80:1	48	....	....	....	....	25	50	100	....	40	60
Linseed oil	40:1	155	0	50	1	55	25	50	100	....	40	60
Linseed oil	60:1	115	0	24	2	....	25	50	100	....	40	60
Cereal	40:1	88	0	12	2	40	100	....	....	....	60	100
No bake	25:1	45	0	10	....	20	0	0	0	0	0	0

Melting Steel *in the* High Frequency Furnace

By Heinz Neuhauss

EDGAR ALLEN & CO. LTD., Sheffield, England was the first steel company to use the high frequency furnace in melting steel on a commercial scale. Since Dec. 6, 1927 that company has been melting 4 gross tons of crucible steel in 24 hours in a 150-kilowatt furnace which has a 400 to 500-pound melting capacity.

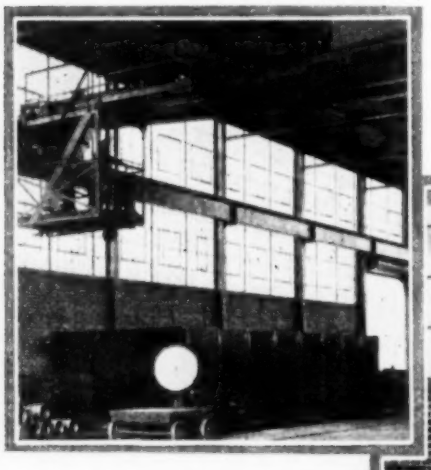
In November, 1926 the Kaiser Wilhelm Institute of Iron Research, Germany, printed in its official publication, Vol. VIII, No. 11, a detailed paper by Wever and Neuhauss on the metallurgy of steel in the high frequency furnace. It showed the possibility of producing the highest

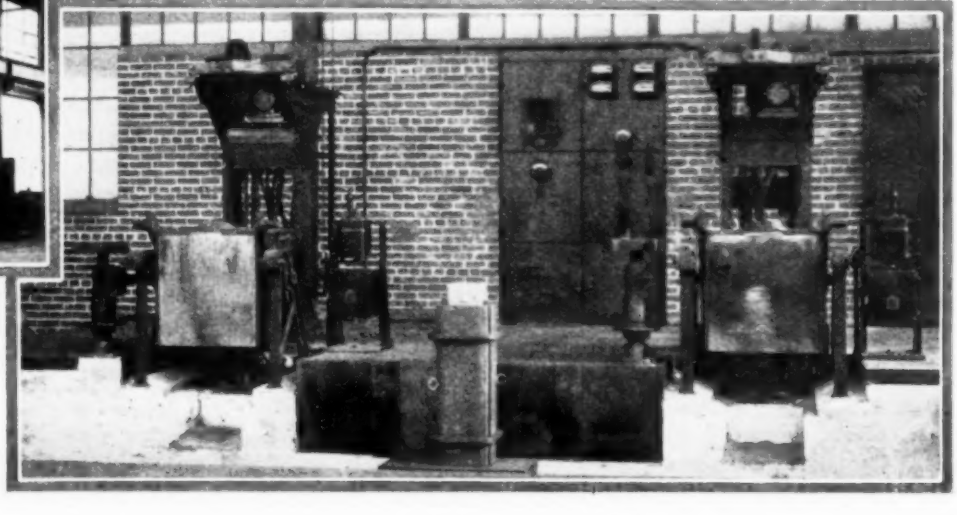
Rapid Melting Is Accomplished

MORE than 250 engineers, steelmakers and heat treaters recently witnessed a demonstration of a 600-pound high-frequency induction steel melting furnace manufactured by the Ajax Electrothermic Corp., Trenton, N. J., at the plant of the Heppenstall Forge & Knife Co., Pittsburgh. Numerous furnaces of that type are installed in this country for melting nonferrous materials and for carrying on research work but the new Heppenstall installation is claimed to be the first unit in this country working steel for production purposes.

High-frequency current developed by a 150-kilovolt ampere motor-generator set is transformed from 60 to 960 cycles. The current is passed through a helical copper coil which surrounds the crucible containing the metallic charge. Friction is developed throughout the charge as a result of the electromagnetic current set up and melting follows without any electrical contact between the coil and the metal. Melting speed is dependent upon the physical character of the charge and in some cases, the analysis of the steel to be made. Under normal conditions, 600 pounds of steel or base metals such as Swedish pig iron and muck bar, can be melted in 50 to 55 minutes in this type furnace.

The container for the metal may be a monolithic crucible or lining tamped in around a core. Refractories for this purpose may be acid, basic or neutral. Approximately 45 heats per crucible have been made.





(Above)—Base Metals Are Stored in Steel Bins Opposite the Furnaces
(Right)—High Frequency Induction Furnaces Each of 600-pound Capacity

Table I

Deoxidation of Pure Iron with Aluminum and Manganese

1		2		3		4	
Deoxidized with: 0.50 per cent aluminum 0.30 per cent manganese		Deoxidized with: 0.30 per cent aluminum 0.20 per cent manganese		Deoxidized with: 0.20 per cent aluminum 0.106 per cent manganese		Deoxodized with: 0.13 per cent aluminum 0.07 per cent manganese	
Time before pouring minutes	Melt-treated	Time before pouring minutes	Melt-treated	Time before pouring minutes	Melt-treated	Time before pouring minutes	Melt-treated
19	liquid	23	liquid	20½	liquid	20	liquid
18	sulphur slag	22	sulphur slag	19	sulphur slag	19	sulphur slag
14	sulphur removed	19	sulphur removed	15	sulphur removed	15	sulphur removed
12	sand added nitrogen on	17	sand added nitrogen on	12½	sand added nitrogen on	12½	sand added nitrogen on
10½	0.50 per cent aluminum added	15½	0.30 per cent aluminum added	11½	0.20 per cent aluminum added	11½	0.13 per cent aluminum added
10	0.30 per cent manganese added	14	0.20 per cent manganese added	11	0.106 per cent manganese added	11	0.07 per cent manganese added
9½	first sample	13¼	first sample	10½	first sample	10	first sample 0.02 per cent carbon 0.071 per cent manganese 0.10 per cent aluminum 0.115 per cent silicon 0.012 per cent sulphur
Pouring 0.03 per cent carbon 0.30 per cent manganese 0.15 per cent silicon 0.52 per cent aluminum 0.009 per cent sulphur		Pouring 0.02 per cent carbon 0.10 per cent manganese 0.32 per cent silicon Trace aluminum 0.010 per cent sulphur		Pouring 0.02 per cent carbon 0.039 per cent manganese 0.12 per cent silicon 0.03 per cent aluminum 0.01 per cent sulphur		Pouring 0.02 per cent carbon 0.035 per cent manganese 0.11 per cent silicon Trace aluminum 0.011 per cent sulphur	

quality steel in that type of furnace.

The most important characteristic of the high frequency or ironless induction furnace is the violent stirring action of the liquid bath due to the *pinch* effect. Importance of this violent stirring of the bath becomes clearer when compared with the conditions existing in other furnaces.

Fig. 1 shows the variation of the carbon, manganese, sulphur and phosphorus content between the bath surface and the bottom of a 7-ton electric arc furnace during the oxidation period. Samples were taken from the bath surface and the bottom at the same time with special apparatus. The experiment showed a variation in the carbon content of 0.17 to 0.10 per cent carbon for 60 minutes in a boiling steel bath (ranging from

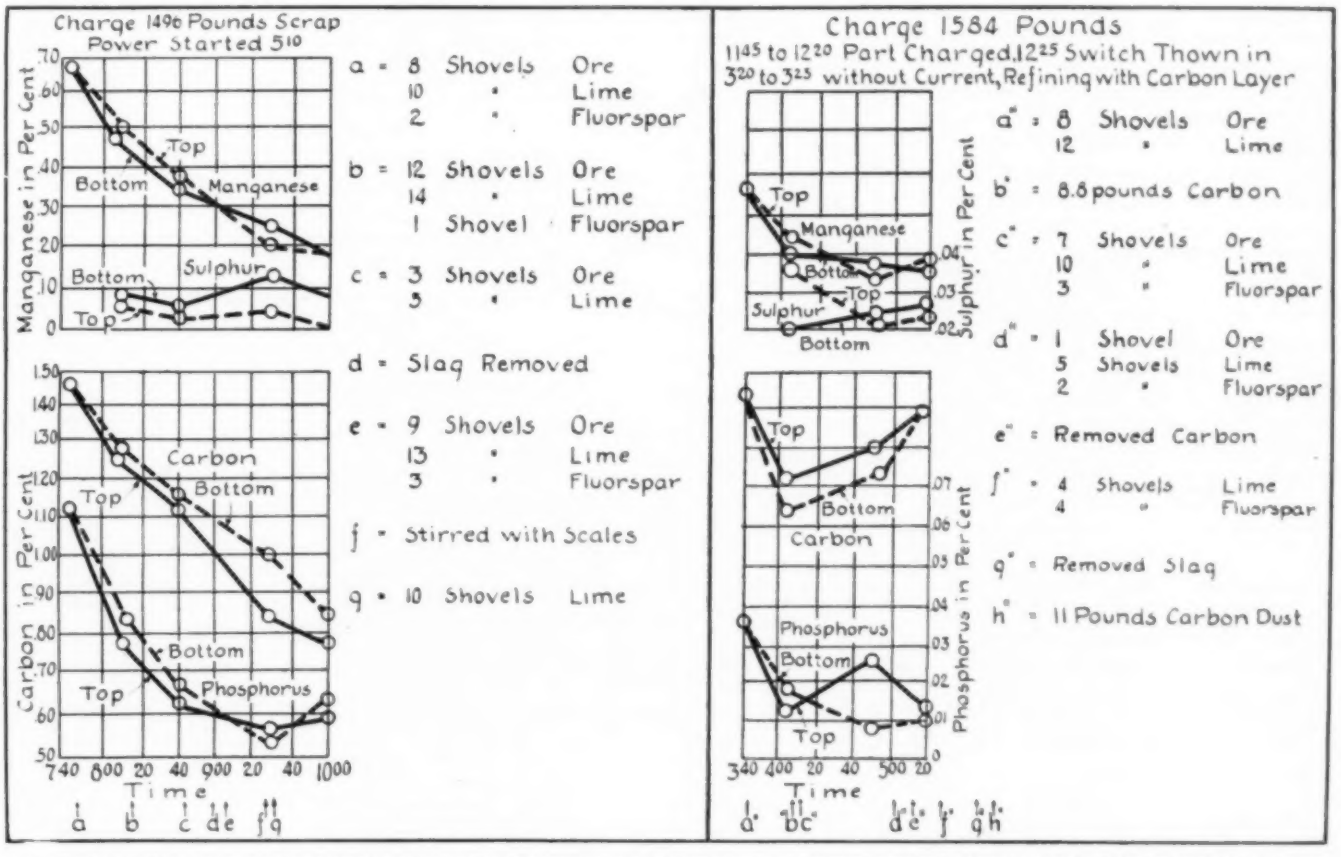


FIG. 1—DIAGRAMMATIC REPRESENTATION OF VARIATION OF CONTENT IN LIQUID STEEL BATH AT TOP AND BOTTOM OF FURNACE HEARTH. FIG. 2—DURING THE OXIDATION PERIOD OPPOSITE REACTIONS MAY TAKE PLACE AT TOP AND BOTTOM OF THE BATH

Table II

Production of Corrosion Resisting Irons

	Coppered Iron	Commercially Pure Iron
Charge Lining	240 pounds moist sand rammed in	240 pounds warm sand
Power consumed in melting	Time: 36 minutes. Average charge: 128 kw. Input in furnace 77 kwh. Input in generator 77 ——— = 102 kwh. (936 kwh. per gross ton) 0.75	Time: 36 minutes. Average charge: 120 kw. Input in furnace: 64 kwh. Input in generator 64 ——— = 85.3 kwh. (783 kwh. per gross ton) 0.75
Power consumed after melting until pouring	Time: 11 minutes Average charge: 62 kw. Input in furnace: 11.3 kwh. Input in gen.: 11.3 ——— = 15.3 kwh. 0.74 (140 kwh. per gross ton)	Time: 18 min. Av. charge: 60.2 Input in fur.: 18.1 kwh. Input in gen.: 18.1 ——— = 24.4 kwh. 0.74 (224 kwh. per gross ton)
Metals used in deoxodizing	0.05 per cent aluminum 0.50 per cent manganese 0.25 per cent silicon	0.05 per cent aluminum 0.50 per cent manganese 0.25 per cent silicon
Time from manganese addition until pouring	6 minutes	8 minutes
Analysis	0.02 per cent carbon 0.34 per cent manganese 0.24 per cent silicon 0.32 per cent copper 0.006 per cent phosphorus 0.011 per cent sulphur	0.02 per cent carbon 0.37 per cent manganese 0.25 per cent silicon 0.48 per cent copper 0.085 per cent molybdenum 0.007 per cent phosphorus 0.009 per cent sulphur

1.10 to 0.80 per cent carbon during the oxidation period) in a depth of 13 to 16 inches. This fact proves that the chemical reactions in a quiet steel bath are completed slowly.

Fig. 2 (also during the oxidation period in the same furnace), shows that directly opposite reactions may take place in this small depth. In this charge two large lumps of coal were laid on the surface while using iron ore for oxidation. It can be seen that dephosphorization proceeds at the bottom while at the same time rephosphorization is going on at the top. Deoxidation with manganese, silicon, aluminum, is carried out according to the usual equation:

Iron oxide plus deoxidation metal equals iron plus deoxidation product (reversible reaction).

The stirring action in the ironless induction furnace facilitates the completion of the reactions in the right direction. Upon addition, the deoxidizers are distributed immediately through the entire charge and the deoxidation products leave the bath quickly as shown in Figs. 3 to 8. In acid, and basic melts, according to Wever and Neuhauss, the deoxidizers were added separately. The curves show the rapid diminishing of the contents of the bath, which is identical with the diminishing of the deoxidation products.

In the quiet steel bath the separation of the deoxidation products proceeds more slowly. A greater concentration of deoxidation products not yet separated into the slag hinders the progress of the reaction in the right direction. Therefore, in the quiet steel bath, it is necessary to use a surplus of deoxidation metals to secure a greater concentration on the left side of the equation, thus obtaining a satisfactory condition of deoxidation.

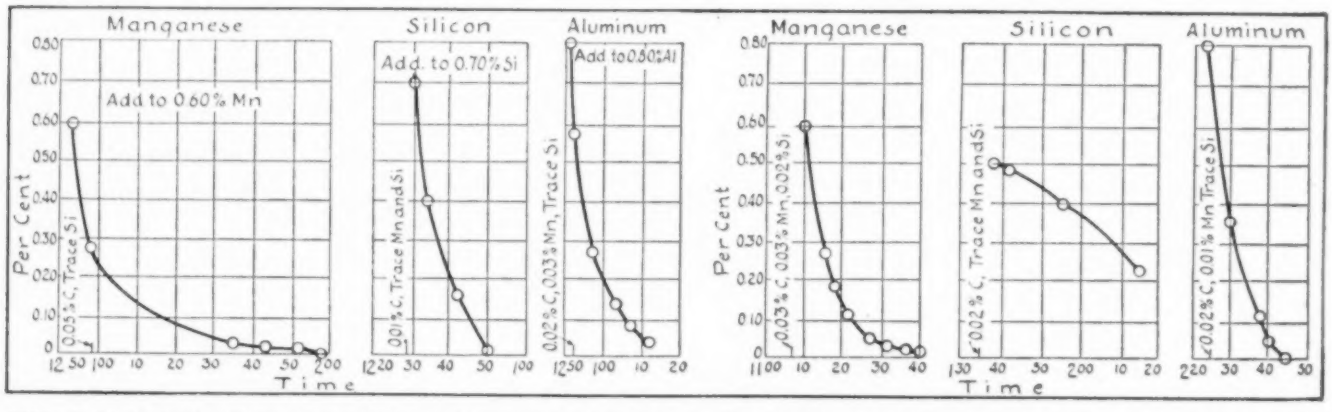
In the arc furnace, it is possible to allow the separation under a white slag, using a longer time. In the open-hearth furnace the metal must be poured shortly after the addition of deoxidizers to prevent a new oxidation through the slag. Here the reactions only will be finished by the stirring during the pouring in the ladle, where the separation of deoxidation products cannot be accomplished satisfactorily. In contrast to this, coreless furnace steel has finished its deoxidation completely before pouring.

It might be thought that by the violent stirring action of the coreless furnace, slag particles are drawn down into the steel. Herty and Gaines, Technical Publication No. 88, American Institute of Mining and Metallurgical Engineers, 1928, have studied this question in detail and have come to the conclusion that such is not the case. Figs. 3 to 8 also disprove this.

Conditions are much more advantageous for the deoxidation with carbon, which can be applied for all steel with more than 0.3 per cent carbon. Solid pieces of carbon are laid on the liquid bath while the rest of the bath surface is covered with a white slag composed of lime, fluorspar and coal powder. By the stirring

Describes Action

ALTHOUGH numerous high frequency electric furnaces have been installed for melting nonferrous metals and for research work, rapid strides are being made in the development of larger sizes and in their application to steel production. This article, the first of two, is presented to give an idea of the action of the furnace and its possibilities in steel production. Heinz Neuhauss, the author, is metallurgist, Ajax Electrothermic Corp., Trenton, N. J.



FIGS. 3 TO 8—DEOXIDATION PRODUCTS LEAVE THE BATH IN A SHORT PERIOD AS MAY BE SEEN IN THE ACCOMPANYING CURVES

action all particles of the bath come in contact with the carbon, so that the iron oxide is all reduced. This deoxidation is ideal because the concentration of the deoxidation product, carbon monoxide, is low.

In the furnaces manufactured by the Ajax Electrothermic Corp., Trenton, N. J., only low carbon steels have been studied up to the present time as carbon apparatus has not been available until just recently. The examples were chosen to give a survey of rust-resisting and stainless steels.

The previouly described rapid progress of the deoxidation makes it desirable to use an oxygen-free atmosphere in the furnace during the washout period so that a complete separation of the deoxidation products can be allowed without fearing new oxidation through the slag. Table I shows the application of this idea. Sample 3 is the limit between the red-short-free sample 2, with too high content of remaining deoxidizers, and sample 4, which is not red-short-free because not sufficiently deoxidized. All these acid melts were treated in the same way.

In melt No. 3, 0.20 per cent aluminum and 0.10 per cent manganese were added after the melt was covered with acid slag and the furnace filled with nitrogen. Immediately after the addition, a forging sample was taken and found to be red-short-free. After 11 minutes under an acid slag and nitrogen atmosphere, the rest was poured and forged without reheating. It was found to be red-short-free although the carbon content was only 0.02 per cent and the remaining total content of manganese, silicon and aluminum 0.193 per cent.

The intention of this article is not to decide the difficult question of producing a red-short-free pure iron, but to show that the violent stirring action opens entirely new metallurgical possibilities. The modern carbon-free iron is not red-short-free and has slag inclusions which aid corrosion to take place.

On a large scale, the above described method is thought to be practicable. For example, an acid lined 5-ton coreless induction furnace may be charged four times an hour with a low carbon, low sulphur and phosphorus, liquid iron made in the open-hearth furnace. Only the deoxidation would be carried out in the induction furnace. A generator of 400 to 600 kilowatts capacity will be sufficient to keep a charge of 5 tons liquid. The small space remaining above the charge easily could be kept oxygen-free in a large furnace.

Table III gives data on a 240-pound melt in the 150-kilowatt furnace, treated the same as the melt described in Table I. The 5-inch ingot from this melt was forged into a round bar and turned down to a 3½-inch diameter. It was then pierced and rolled in a seamless tube mill at the Ellwood City, Pa., plant of the National Tube Co. The tube free from all defects both inside and outside, was exhibited at the National Metal exposition held in Philadelphia, October, 1928. Seamless tube rolling, the heaviest treatment of steel metallurgy, has been chosen to show that it is possible to make an absolutely sound iron with low final contents of deoxidation metals, which proves that the stirring action of the ironless induction furnace is helpful for the deoxidation.

Calculated power consumption per ton using the result of a 240-pound charge does not give a true estimate because the heat losses of a small open-top crucible are proportionately much greater than a large closed top furnace.

Coppered iron and commercially pure iron melts shown in Table II were treated like pure iron. If the described pure iron with only 0.19 per cent total manganese and silicon and aluminum is red-short-free, one may conclude that further additions form alloys rather than partially oxidized inclusions. Coppered and commercially pure iron produced in this way should have a specially corrosion resistant property, because in such a material the characteristics of

Table IV

13 Per Cent Chromium Steel

Charge	188 pounds commercially pure iron 52 pounds Goldschmidt ferrochromium
Lining	moist sand rammed in
Power used in melting the base iron.	Charge: 188 pounds Time: 55 minutes Average charge: 88 kilowatts Input in furnace: 80 kilowatt hours Input in generator: $\frac{80}{0.74}$ = 108 kilowatt hours
Power used in melting the addition and finishing the melt.	Addition: 52 pounds Time: 13 minutes Average charge: 123.5 kilowatts Input in furnace: 26.8 kilowatt hours Input in generator: $\frac{26.8}{0.75}$ = 35.7 kilowatt hours (327 kilowatt hours per gross ton)
Analysis	0.09 per cent carbon 0.47 per cent manganese 0.88 per cent silicon (too high) 0.013 per cent sulphur 0.007 per cent phosphorus 0.08 per cent aluminum 12.68 per cent chromium

Table III

Low Carbon Red-Short-Free Iron

Charge—240 pounds commercially pure iron in acid lining.

Time before pouring	Melt treatment	Power input in furnace
12 minutes	Acid slag molten	30 kilowatts
9 minutes	Nitrogen opened	30 kilowatts
8 minutes	0.20 per cent aluminum added	30 kilowatts
7 minutes	0.20 per cent manganese added	45 kilowatts
6-3 minutes	.....	45 kilowatts
2 minutes	.....	35 kilowatts
Pouring	Of nitrogen	.....

Power consumption during the last 15 minutes in which took place the deoxidation until pouring:

Average charge	35.4 kilowatts
Input in furnace	8.85 kilowatt hours
Input in generator	$\frac{8.85}{0.74}$ = 11.95 kilowatt hours

For one gross ton, 111 kilowatt hours.

Analysis: 0.03 per cent carbon
0.15 per cent manganese
0.07 per cent silicon
0.09 per cent aluminum
0.005 per cent phosphorus
0.010 per cent sulphur

pure iron and the corrosion resisting metals are combined. Both steels were pierced and rolled into flawless seamless tubes and exhibited at the exposition previously mentioned.

For the production of stainless steel the following adaptions of the high frequency furnace have been pointed out:

(a) Alloying a low carbon bath with low-carbon ferrochromium.

(b) Alloying a low carbon bath with cheap, high-carbon ferrochromium and decarburizing without notable loss of chromium.

(c) Decarburizing of high-carbon ferrochromium in the high frequency furnace and adding it to a decarburized steel bath made in another furnace.

(d) Producing a 14-15 per cent chromium containing pig iron directly from the ore in the blast furnace and decarburizing in the high frequency furnace.

Table III shows all data from a stainless steel melt falling under (a). A flawless seamless tube rolled from this material, rolled at the Ellwood City, Pa., plant of the National Tube Co. was also exhibited at the National Metals exposition in Philadelphia.

Fig. 9 and Table V show a stainless steel melt falling under (b). This idea was proposed by Prof. F. Wuest and tried (1926) in the German Iron and Steel institute. Fifty-nine minutes were necessary to decarburize the bath from 1.15 per cent carbon to 0.05 per cent. The fact that the power consumption in a big furnace is much less than noted in the Table V must be remembered.

This material was also rolled into a seamless tube and was exhibited in Philadelphia. As the tube had a few defects, it was not entirely satisfactory. Doubtless more practice in decarburizing will prevent the over-oxidation of the metal. Only one melt has been made here.

Fig. 9 shows that the oxidation was continued too long. The carbon content between the last two analyses is less than 0.04 per cent. The ultimate carbon content of 0.04 per cent has been added partly during the later deoxidation by the use of ferromanganese with high carbon content.

Bearing in mind that the decarburization was done by the use of iron oxide and by blowing cold air on the bath surface, it is concluded that the whole process could be completed in a shorter time by using preheated air and a larger furnace.

Frederic B. Brings Out Another Book

Several years ago—to be exact in 1915—Frederic B. Stevens, at that time, also before and since a resident of the city of Detroit, decided that what the world, particularly the foundry world, needed was a worth while book to read. Many men have had the same idea, but there they have bogged down. Frederic B. did not bog down. He sat down and wrote

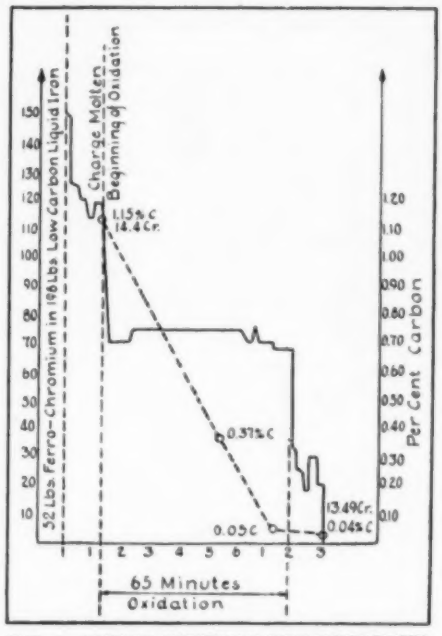


FIG. 9—CURVE SHOWING THE DECARBURIZATION OF A STAINLESS STEEL MELT

the book, christened it *This and That*. The great reading public licked its lips figuratively over the tasty morsel and clamored for more. As a result the author drew upon an apparently inexhaustable fountain of wit, common sense, and incidents in a long and busy life and produced eight companion volumes since that time. The latest number is known as *Tell Tale Tales*. The reason it is called *Tell Tale Tales* is because it is one of an alliterative series built around the letter *T* and not—as you might be led to conjecture—because the subject matter is anything of that nature. For the benefit of recent arrivals the titles of the other seven publications follow: *That and This, This That and Then, This That Those and These, T'Other and Which, That That Is Is, Thus and So, Then and Now.* Following out his original idea that the foundry world needed a worth while book he first prepared the book and then to remove the last stumbling block he decided to give the book away free to any interested person. Furthermore he instructed the printer to enclose the 94 pages of delicate cream colored paper nicely bordered in red, in an attractive black and red cover. The book will stand re-reading many times and for that reason it has been designed cunningly to fit in the coat pocket of the gentleman who secures it.

Book Review

Handbook of Domestic Oil Heating, by Harry F. Tapp; first edition; flexible, 383 pages, 4¼ x 7¼ inches; published by American Oil Burner association, 342 Madison avenue, New York, and supplied by THE FOUNDRY, Cleveland, for $3, or in Europe by the Penton Publishing Co. Ltd., Caxton House, London, for 15s, net.

This book is written in language that is easily understood by both the layman and the technician. It gives definitions of many common terms that are used in the heating and ventilating profession. It also designates various types of apparatus for determining values such as temperature, humidity, air velocity, etc. One of the features of the book is a set of tables giving the coefficients of heat transmission through different types of building walls. Oil as a fuel, its characteristics and properties are given. Burning fuel oil in homes is discussed; methods of control, equipment, storage, piping, construction of boilers and furnaces, hot water and steam heating systems and warm air heating are some of the other topics discussed. Tests and installation, sales and service, and ordinances governing oil heating installations are given. The latter part of the book is devoted to miscellaneous information and tables of interest to the heating and ventilating engineer.

Appoints New Managers

H. L. R. Emmet has been appointed manager of the Erie, Pa., plant and J. E. Brobst has been named manager of the Bloomfield, N. J., plant of the General Electric Co., Schenectady, N. Y. Mr. Emmet succeeds Mathew Griswold and Mr. Brobst succeeds C. D. Knight both of whom retired from active service on Jan. 1, because of ill health. Mr. Emmet has been with the General Electric Co. since 1912 and has been production manager of the Schenectady works since 1922. Mr. Brobst has been with the company since 1903 and since 1920 has been engineer in the industrial control engineering department at Schenectady. He will continue to act in the capacity of engineer of the industrial control department, having general supervision over the engineering departments at both the Schenectady and Bloomfield plants of the company.

British Firm

Anneals Cast Iron

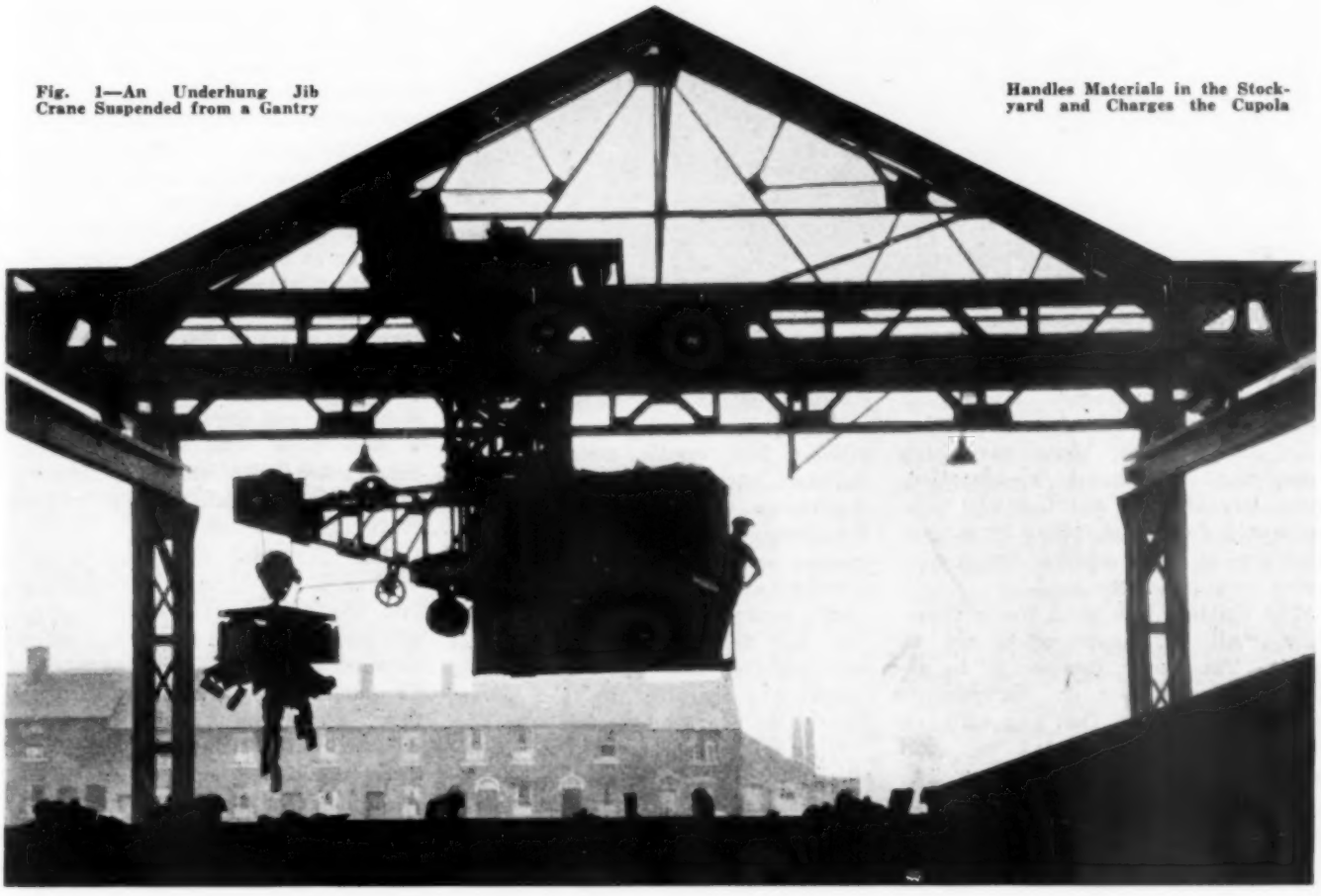


Fig. 1—An Underhung Jib Crane Suspended from a Gantry Handles Materials in the Stockyard and Charges the Cupola

WITH a continuous existence of approximately a century and a half, the firm of John Harper & Co., Ltd., operating the Albion Works, Willenhall, South Staffordshire, is recognized as one of the oldest in Great Britain engaged in the manufacture of gray iron and malleable iron castings. The company has catered particularly to the electrical, hardware and domestic machinery field, in which the weight of the individual castings does not exceed a few hundred pounds.

Hydraulic and pneumatic molding machines are employed extensively to produce castings of the greatest accuracy to fit the jigs in customer's machine shops. A high surface finish is regarded as a necessity. Castings are given a special heat treatment which affects the grain structure to such an extent that machining operations are carried on at maximum speed.

Demand for gray iron castings in the electrical industry became so great in 1925 that the company discontinued the manufacture of malleable iron castings and devoted all its efforts and facilities to the manufacture of gray iron castings. The annealing furnaces were removed and a new gray iron foundry was erected and placed in operation on the site. Later the entire area of the plant, 3 acres, was utilized and for more than a year both night and day forces were employed.

Continued expansion led the company in 1927 to decide upon the erection of an entirely new plant on a 30-acre site located about ¼-mile from the existing plant. This property had been in the company's possession for a long time and is situated advantageously at Clarke's Lane, Willenhall near Short Heath station on the London, Midland & Scottish railway. Modern and laudable features in construction, equipment and operation were adapted freely from the most progressive foundries in Great Britain, America and the continent of Europe and incorporated in this new foundry.

A definite scheme of development has been adopted by which the plant may be expanded to meet conditions as they arise. The two sections recently completed have absorbed all the new work and the overflow from the old foundry. This old foundry still is operated to ordinary capacity, but eventually all the work will be taken care of in the new plant. Operations gradually will be moved from one plant to the other to meet the build-

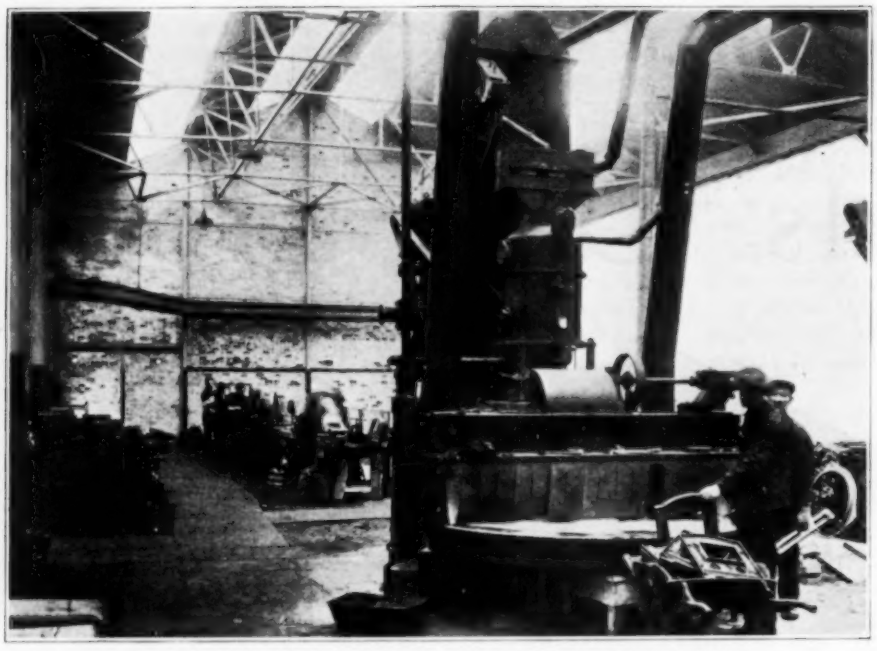


FIG. 2—CASTINGS ARE SANDBLASTED BEFORE INSPECTION

ing program and the installation of facilities and equipment.

At present two main production bays and a power house have been completed and placed in operation. Each bay is 45 x 400 feet and only separated from each other by a central row of steel columns which also serve to support the roof.

The building is a steel frame structure. All permanent walls are of brick. Their only function is to afford shelter. They do not support any of the load. The monorails on both sides are supported on steel members attached to the columns. The roof has been well braced to take care of the strain incident to the installation of electric overhead runways at a later date. The roof as may be noted in Figs. 3 and 4 is transparent over half its area and represents a patent glazing process in connection with a protected metal sheeting. Artificial lighting has been installed on a similarly generous scale. It is claimed that actual tests with a foot candle meter show a uniform intensity of 5 to 6 foot candles on the floors and machines.

A transverse bay 18 feet in width extends across the center of the two existing bays and will be continued in other sections as they are added. This bay facilitates the transfer of materials from one bay to another and enables the operators to take advantage of the overhead electric travelers.

With the exception of one section set apart for molding the heavier castings the entire foundry is floored with concrete, a form of construction which greatly facilitates the transport of materials on various forms of trucks and barrows.

Electric current for operating the plant is taken from the local Supply Co., at 7000 volts and is stepped down to 440 volts and 220 volts respectively for utilitization in the power and light units. Two compressors supply all the air required up to the present. One maintains a pressure of 30 pounds per square inch for sandblasting purposes. The other supplies air at 80 pounds per square inch pressure for the molding machines.

The powerhouse in which this equipment is contained has been designed for the reception of duplicate equipment, also for the hydraulic power units which will be required for the new molding bays to be erected in the near future.

Following the prevailing custom in a country where the winter climate is not severe the charging platform has been roofed, but is not enclosed at the sides or at one end. The platform 30 x 45 feet is located 16 feet above the ground level. One side of the platform is occupied by a coke storage bin with a capacity of 50 tons. That part of the platform nearest the stockyard and separated from it by a steel plate wall 4 feet high has been fitted with steel partitions to form bins in which the pig iron and scrap are classified.

Coke is lifted 2500 pounds to a load on a special skip and discharged into the coke storage bin. Pig iron and scrap are lifted by a 1-ton magnet suspended from a special type crane. This underhung jib crane is suspended from a traveling bridge or gantry mounted on a runway that extends from the inner side of the charging platform to the outer edge of the stockyard. The crane unloads the raw material in the stockyard, lifts it to the charging platform, loads the drop bottom charging buckets and afterward introduces them into the cupola where the load is discharged. The gantry rail rests 32

FIG. 3—THE FLOOR IS LIGHTED ENTIRELY THROUGH SKYLIGHTS. FIG. 4—VIEW FROM EAST BAY LOOKING SOUTH SHOWING TWO BAYS RECENTLY COMPLETED

feet above the ground level and the crane has a rated lifting capacity of 4 tons. Charges are weighed accurately before they are placed in the cupola. Many of the interesting features connected with the charging platform are shown in Fig. 1.

The cupola is housed in a room adjoining the main building near one end. An extension tilting spout carries the metal from the regular spout of the cupola to a procession of ladles suspended from a monorail extending completely around the foundry. A pair of rolling steel doors takes the place of the half wall or whole wall usually found in front of a cupola. These doors are kept closed before and immediately after the heat when the bottom is dropped. The cupola is provided with a high wind belt into which air from the blower is delivered through two vertical pipes located above the wind belt and diametrically opposite each other.

In addition to the regular type of ladle shown to the right and left of the cupola in Fig. 5 a drum ladle shown in the center or almost in front of the cupola spout also is employed for distributing and pouring the iron. The advantage claimed for the drum ladle is that the heat of the molten iron may be maintained for a longer period than where the usual open top ladle is employed. Also it lends itself more readily to direct pouring into the molds.

Facing sand is prepared in a semi-automatic plant shown in Fig. 6 which eliminates all intermediate handling. Old sand, new sand and coal dust are fed into individual hoppers below the floor level. These hoppers are equipped with measuring and distributing tables which deliver the correct amount of each constituent into a single elevator. The combination passes through various stages

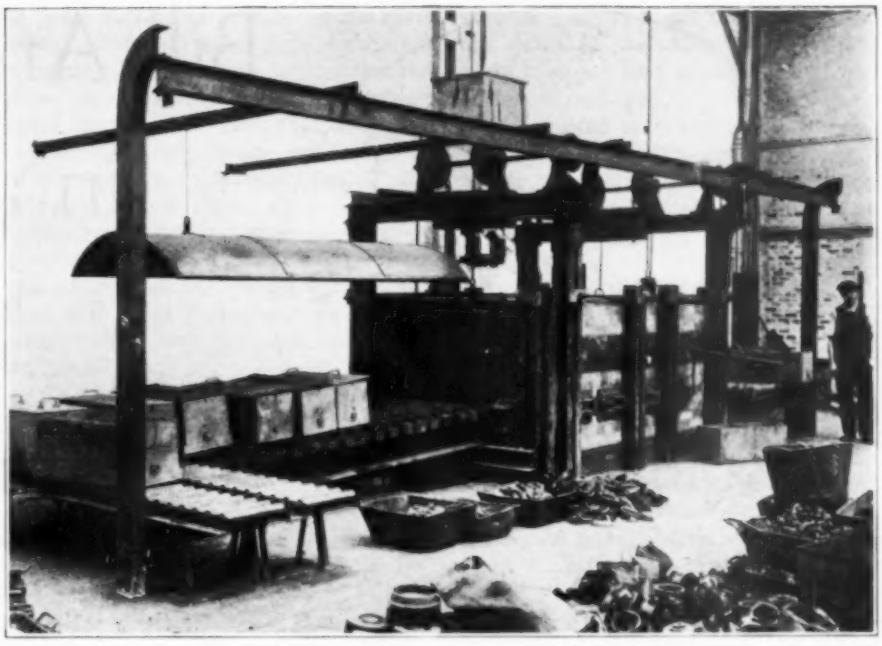


FIG. 7—CASTINGS ARE PASSED THROUGH A CONTINUOUS ANNEALING FURNACE

and finally is delivered in finished condition into a large storage bin.

Old sand is brought to the mill in special tubs mounted on automotive trucks. An air hoist lifts the tubs and dumps the contents into the hopper. The tubs then are filled with the prepared facing sand and returned to the various molding stations.

All castings leaving the foundry are sandblasted before they arrive at the inspection department. This precaution practically ensures the rejection of all defective castings before any further work is expended on them Castings are placed on a rotary table which carries them automatically under the sandblast nozzles and out again in constant procession.

After the castings have been cleaned and inspected they are annealed in the furnace shown in Fig. 7. This furnace is of the continuous oil fired type and is fitted with a recording pyrometer so that a record may be kept of the temperature maintained on each charge. Continued experiment over an extended period has resulted in the adoption of definite temperatures and definite annealing periods for various classifications of castings.

The furnace is fitted with roller loading tables and hydraulic pusher gear. With the entrance of each load at one end of the furnace a corresponding load is discharged at the other end on to a gravity roller conveyor beneath a cooling hood. After the castings have cooled the boxes are emptied and returned to the charging end where they are reloaded to continue the cycle.

Cores are dried in two large ovens located on the floor level and heated

(*Concluded on Page* 162)

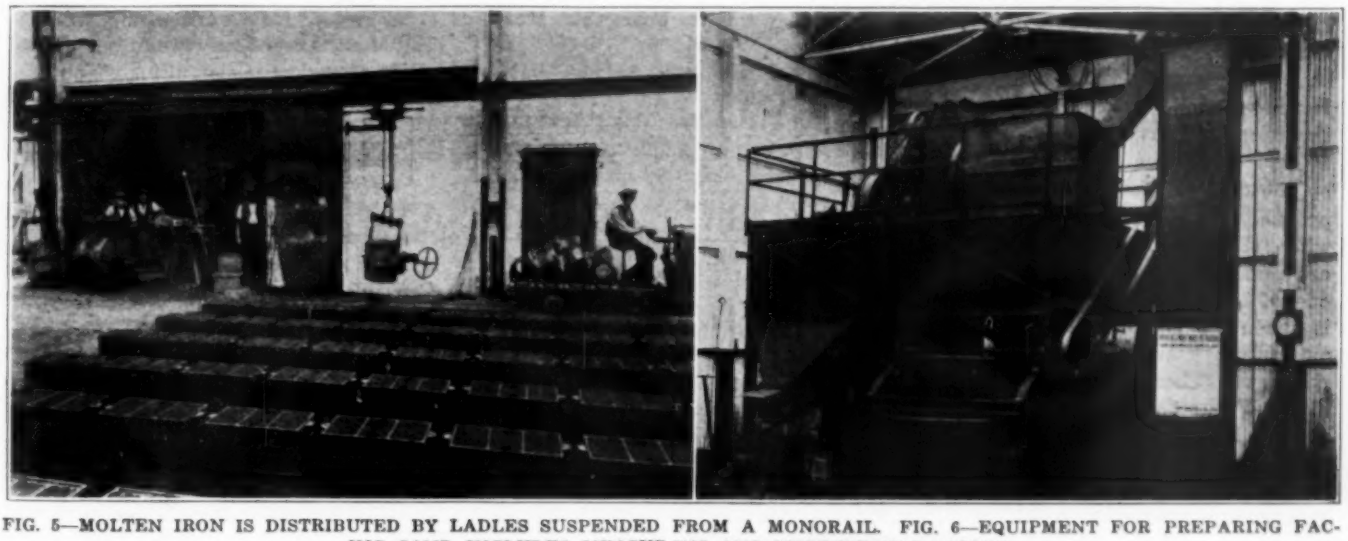


FIG. 5—MOLTEN IRON IS DISTRIBUTED BY LADLES SUSPENDED FROM A MONORAIL. FIG. 6—EQUIPMENT FOR PREPARING FACING SAND INCLUDES MEASURING AND DISTRIBUTING TABLES

Bill Anchors a Pipe in a Casting

By Pat Dwyer

SAY," said Bill the other night, "did you see the story in tonight's paper about the two horses who ran away?"

"No," I replied in the most friendly manner. "Did you?"

"Did I?" Bill asked in surprise. "Why should I ask you if you had seen the story if I had not seen it already?"

"Search me," I said. "Why do you ask any questions? To tell you the plain, honest truth, man to man and so forth, I think it is a habit with which you are afflicted. In the majority of instances I think you ask the questions simply for the pleasure of asking them, or for the doubtful pleasure of hearing yourself answer them.

"I will go a step farther and claim that in some instances you invent both question and answer. Take this horse story for example. You know as well as I that the horse practically is extinct. To my certain knowledge, outside of one fastened to a milk wagon and another old wreck drooping between the shafts of a junk cart, I have not seen a horse for months. Neither one of these is in the runaway class. Judging by the language employed by the drivers these animals probably will drop dead when the supporting shafts are removed. The only time one of these things will run is when he is run through a sausage machine. Even then, ten chances to one, his big hoofs and worn shoes will jam the machine and wreck it. Finally, and this is the point which aroused my suspicion in the first place, what authority have you for referring to a horse as *who?* Two horses who ran away! You will be telling me next about the bird what caught 'em. Probably these wonderful horses could talk and for that reason—"

"No," Bill explained, "these horses could not talk and for that reason they said nothing. In that way they displayed more intelligence than a certain human being, name given on request. Lay off the silly stuff and listen for a minute while I tell you the story of the two horses."

"A tale of two horses, eh? This is not a sequel to the Four Horsemen of the Apocalypse, is it?"

"No," said Bill impatiently, "and for your further information it has no connection with the wooden horse of Troy, Charlie horse, my kingdom for a horse, horse chestnuts, hors d' ouvers, horse and horse, horse shoes, hobby horses or the horse who saved the day at Winchester 20 miles away."

"How about Paul Revere?" I reminded him. "Did you forget him? You should ring in the patriotic touch—"

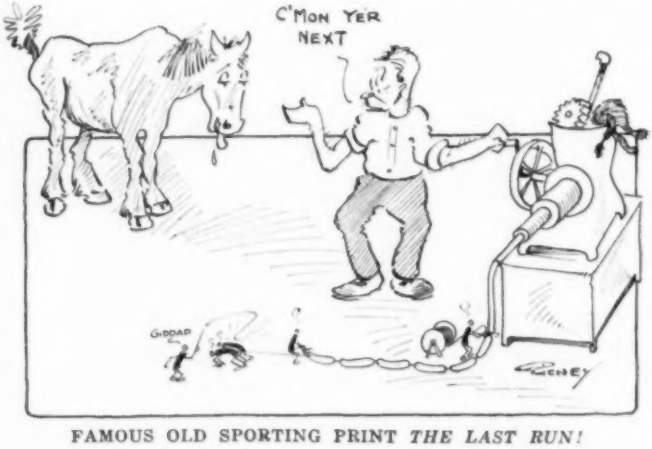
"He's out, too," said Bill. "Say! Do you want to hear this story or don't you?"

"No," I said. "I do not, but why bring that up? I am too comfortable to move. Go ahead—to borrow one of your own expressions—spill it. I have only one dying request to make—cut it short."

"How the—Say! How am I going to cut it short with you everlastingly butting in? I could have finished the story half an hour ago, if you had been satisfied to give that gab trap of your's a rest. Why do you suppose a benevolent Creator hung those long ears on the sides of your head? Certainly it was not for ornament. Exercise 'em once in a whole or some day you will wake up to find the passages closed. Then you will have to get a horse doctor to ream them out with a rat tail file or a sprue cutter. I knew a fella one time—"

"I knew him, too," I interrupted. "He had as fine a pair of ears as you could find in a long day's walk. Sharp, discriminating ears that had served him faithfully over a long period of years. They had been tanned in summer and frozen in winter. They had warned him in time of danger and stress and had thrilled to the whispers of little children—and others who were not so little. Then one day a fella told him a story about a pair of horses. He dragged the story out to such an extent that the ears practically were ruined. Worn out, that's what they were, just worn out."

"Must have been two other fellas," Bill remarked cheerfully. "You ain't heard this story yet." "Well, whose fault is that?" I wanted to know. "If the horses were as slow as you have been in getting started, you will have to go some to make me believe they ran away at all. Did you see them run?" "No," said Bill. "I did not see them run. If your memory was not in the discard with whatever other faculties you were endowed with originally, you would remember that I said I had seen this story in the evening paper."



FAMOUS OLD SPORTING PRINT *THE LAST RUN!*

"My memory may be slipping," I admitted, "but it has not slipped to the point of allowing you to put anything like that over on me. According to my recollection—kindly correct me if I err—you asked me if I had seen the story. Seems to me—If I am mistaken, remember I am open to reasonable conviction—seems to me a slight discrepancy, slight, but apparent to a sensitive ear, may be noted between the two statements. How about it?"

"'Pon my word," Bill cried in despair. "I have a good mind to leave you flat and not tell you the story."

"Let us give three of those cheers," I shouted joyously. "Stick the horses in the barn and forget them. I never have read a horse story that was worth the paper on which it was printed."

"That's because you did not read this one," Bill replied eagerly. "If you had you would change your mind. It seems these two horses—" "Well," I said, "I suppose if I must listen there is no alternative. The story apparently is boiling and bubbling inside and if you do not get it out of your system you will blow a fuse or explode in a shower of small sticky pieces. I would not mind if you were outside, but I hear enough and to spare now when a certain party finds a few matches and a little ashes spilled on the floor. Purely as a defensive measure and in no wise to be regarded as contributory negligence on my part I will listen. What did you say were those horses' names?"

"How do I know what their names were?" Bill asked irritably. "May have been Jack and Jill for all I know, or Sodom and Gomorrah. The lad who wrote the story omitted that detail. Anyway, what difference does it make? A horse by any other name smells just like a livery stable on a warm day. Let's call 'em Pete and Repeat. As I was saying—"

"I might just as well tell you now," I said, "that I am inclined to view the story with the most profound suspicion. That admission of yours gives the story just that fishy smell that serves as a warning to all experienced newspaper readers. Don't you know that every newspaper reporter is under threat of instant and violent death if he turns in a story without including the name, address and age of the central figure or figures? According to my limited experience these nimble boys take the path of least resistance and fill in the foregoing details from their exuberant imaginations. To save their lives and their jobs, they invariably include these items. The fact that the main essentials of the story were omitted in this instance indicates one of two things. Either the story is pure horse-drawn fiction, or it is a badly garbled version of what really happened. A man who would mangle the first and most important part of a story would not hesitate to distort the remainder."

"I'd hate to have a suspicious mind like your's," Bill said. "It is worse than an ingrowing conscience or a large and well developed complement of ingrowing toe nails on your old yellow feet. Would you believe the story if I told you it started in the following manner:

HOW TO REDUCE THE HIGH COST OF LIVING

At 4:17 this afternoon while the main street was crowded with the usual matinee crowd, Heloise and Abelard, rising 10 and sound in wind and limb, a beautifully matched pair of grays from the Hotel d' oat, corner of fashionable Hay Street and Bran Mash Boulevard, for some unexplained reason suddenly decided to make whoopee and dashed madly down the street.

"That last touch ruins it," I said. "Any time I come across that idiotic expression *whoopee* I throw the paper in the fire. Long experience has taught me that the succeeding paragraph will contain a painfully labored effort to work in some reference to the unfortunate person *who faw down and go boom.* That is the absolute limit. If you tell me these horses *faw down and go boom* I'll bounce this poker off that round knob which keeps your ears apart. Be-w-a-r-e Eustace deVincy! I will hesitate at no obstacle."

"Keep your shirt on," Bill replied complacently. "These horses did not *faw down.* In fact they did everything else *but* fall down. They stopped under the most extraordinary circumstances and that is what constitutes the point of the story I read in tonight's paper and which I have been trying to tell you."

"I am glad to hear the story has a point," I said. "From the manner in which you have been beating about the bush for the past half hour I was beginning to wonder if it even had a beginning."

"Certainly it has a beginning," said Bill. "I have told you more times than I can remember that the horses ran away. That is the beginning. I also have told you they stopped and that is the end. Now if you will listen—"

"Why should I listen any further," I inquired. "You have told me the beginning and the end. What else is there to tell? So far as I am concerned the session is over. I hope you have not the supreme—er—effrontery to expect that I will sit here patiently while you go all over the dreary details again." "What details?" Bill asked in surprise. "Dear lad you ain't heard nothin' yet. I may have told you the beginning and the end, but the extraordinary circumstances under which these horses stopped contains a moral or something of that kind on which you might ponder with advantage to yourself — a n d others."

"Who ever heard of any horse with such a thing as morals?" I objected. "I have heard of horses afflicted with the heaves, with spavins, botts and glanders, but I'll tell the world you are the first person to discover one with morals. Did these horses by any chance also have nice curly hair and a meek expression?"

"I did not have the extreme pleasure of knowing these horses personally and intimately," Bill replied with ponderous sarcasm, "therefore I cannot answer the question of the gentleman with the vacant face and ferrety eyes. If he kindly will stick a plug in that vacuum above his neck I will relate the story as I read it in the paper.

"Go ahead," I said wearily.

"This afternoon two horses attached to a heavily laden wagon were proceeding west on St. Clair Ave. Probably in the course of their daily routine they had covered the ground hundreds of times with no untoward incident. Today as they crossed Ontario Street a wind blown newspaper slapped them on the noses and immediately converted the two peaceful old

plugs into a pair of raging demons. They reared simultaneously and then went tearing down the street at break-neck speed. The sudden jerk threw the driver back from the seat. He landed among the miscellaneous cargo and a minute afterward was bounced over the side with two crates, a small barrel and seven tin pails. Other items hopped out at irregular intervals as the snorting animals tore along. Sparks flew from the pavement and terrified motorists hugged the curb on either side.

"Pedestrians dashed into doorways, women screamed and small boys dashed along behind, eager to see the finish. Strong men held their breath, instinctively visualizing the ensuing wreck and ruin when the tornado should strike the north and south bound traffic at West Third Street.

"Ten and a half seconds before the horses arrived at the intersection, the traffic light flashed from green to yellow to red and I'm a pair of pickled pig's feet if those two rarin' Romeos did not brace their feet and skid to the line!"

"Well," I inquired, "what's the moral?"

"The moral," Bill replied, "Is, always have your red light ready. I was reminded of this the other day by an inquiry from a foundryman who was having trouble in keeping a long pipe in place in a casting. Any person who has tried to make one of these castings, knows how the pipe wiggles like a snake and cuts through in the most unexpected places. This man was trying to make a cast iron bosh plate 4 inches thick, 9 feet, 1 inch in length, 14 inches across one end and 19 inches across the other end. The heavy 1¼-inch steel pipe was bent in a loop at the wide end. The two members extended almost to the narrow end where they were bent vertically to project through suitable bosses in the casting. He had tried special chaplets, also hooks driven in the bottom board. The pipe was filled with fine, sharp sand, but after the casting was poured the sand could not be removed. He asked if it is feasible to flow water through the pipe and if so how is it done.

"Under certain circumstances water may be flowed through a pipe coil in a casting and the only precaution to be observed is to have the water flowing before the first iron is introduced. However, in this case this is not necessary. Neither does he need any sand in the pipe. The heavy steel pipe he is using will not melt or buckle in the casting described. It will expand in length over an inch and will contract in diameter a little. These two features cause all the trouble if proper precautions are not observed. The expansion causes the pipe to buckle and cut through if it is held rigidly by the chaplets. The contraction causes it to fuse any sand on the inside under pressure.

"The trick in making castings of this kind is to leave the pipe empty and to provide chaplets that will allow the pipe to expand longitudinally. This is accomplished by using cast iron chaplets similar to those shown in the accompanying sketch. They are plain cast iron blocks approximately 2 inches square, 4 inches high (the thickness of the casting) and split in two so that one half supports the pipe on the bottom while the second half rests on the top. The opening in the chaplet block is slightly larger than the pipe so that the pipe may slide through while expanding. One chaplet is placed at the center of the loop and the others are spaced about 2 feet apart on the straight lengths with a pair placed as close as possible to the end where the pipe turns downward.

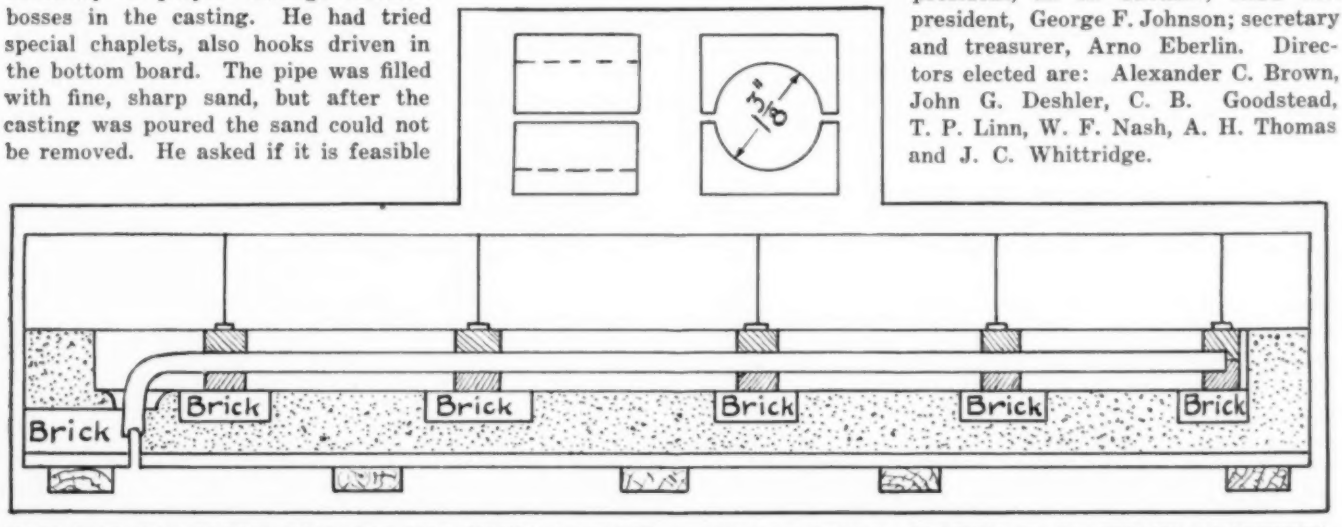
"A brick or piece of plate supports each chaplet in the drag. If the cope is skin dried no chaplet is required to hold the top half of the cast iron chaplet block. In a green sand cope an iron block, a piece of dry sand core or brick, or a regular chaplet may be employed. The expansion of the pipe must be directed toward the loop end. An iron block, a plate or brick braced against the end of the flask will prevent the two outlets of the pipe from moving in that direction and thus will hold them in the center of their respective bosses. Two holes are bored in the bottom board for the escape of the vent from the pipes. The chaplet blocks are ground smooth and oiled or painted with red lead so that the iron will grip them and lie against them quietly.

"You may be interested to learn that in several places castings of this kind are poured in open sand. The same kind of chaplets are employed with suitable blocks on top to allow an opportunity of wedging them down under rails that support the weights. While it is true that the pipes will not melt, still reasonable precaution must be observed in pouring the metal. The stream should not be directed against the pipe and it should not be poured too hot.

"Every person has his troubles," Bill concluded reminiscently. "Even the clergy are not immune. I heard the other day of the rector of a small parish whose means were limited, woefully. One of these nosey friends who always are asking tactless questions—please take note—asked him what he lived on. Without batting an eye—his own or that of the n. f.—the little hero answered gallantly: 'I live on faith. My wife lives on hope and the children live on charity!'"

Foundry Elects Officers

Buckeye Steel Castings Co., Columbus, O., has re-elected its officers, as follows: President and general manager, J. C. Whittridge; first vice president, John G. Deshler; second vice president, A. H. Thomas; third vice president, George F. Johnson; secretary and treasurer, Arno Eberlin. Directors elected are: Alexander C. Brown, John G. Deshler, C. B. Goodstead, T. P. Linn, W. F. Nash, A. H. Thomas and J. C. Whittridge.



SPLIT CAST IRON BLOCKS HOLD THE PIPE FIRMLY IN PLACE VERTICALLY WHILE ALLOWING IT TO EXPAND LONGITUDINALLY UNDER THE INFLUENCE OF THE MOLTEN IRON

Program Nears Completion

American Foundrymen's Association Provides Exceptional Features For Chicago Convention and Exhibition Scheduled for Early April

SUBJECT possibly to some slight revision due to unforeseen circumstances, the tentative program for the 1929 convention of the American Foundrymen's association, Chicago, April 8-11, practically has been completed and compares favorably with the high character of programs presented on former occasions.

From the list of papers submitted, the committee appointed for the purpose has selected a sufficient number to constitute a balanced program dealing with foundry practice in its relation to the four main divisions of metals, gray iron, malleable iron, steel and nonferrous metals.

The number of papers has been restricted to afford time for extended discussion at each session. The same idea is carried out by arranging for round table luncheon meetings where particular and topical problems of the industry may be discussed in a more general and less informal manner than obtains at a regular session. Former experience with meetings of this kind has convinced officers and members of the association of their practical appeal and usefulness.

Although not so large or operated on such a spectacular scale as in Philadelphia last year, the exhibition of foundry supplies and equipment to be shown this year in the Stevens hotel promises many features of interest and will serve to round out the informative impressions taken away by those who come to see as well as to hear. The fact that the exhibition is housed in the building where the various meetings and other functions are held, also that it lies in the direct path of those passing from one meeting place to another, will be appreciated by those who desire to conserve their time and derive the greatest benefit from their attendance at this, the thirty-third, convention of the association.

The first regular technical session will open Monday, April 8 at 4 p.m., and will deal with the subject of pouring practice in the steel foundry. A simultaneous session will take place in another room for the benefit of those interested in gray iron foundry practice. This meeting will consider the subject of cupola control.

Preliminary work, registration, viewing the exhibition and general settling down will occupy the early part of Monday. Various committee meetings have been arranged for 1 p.m.

The exhibitors' dinner and entertainment which has come to be regarded as one of the major features of the American Foundrymen's association conventions in recent years is scheduled for 6:30 p.m. Monday, April 8. Instructors in engineering and foundry practice also other men connected with apprenticeship and training movements have arranged for a dinner meeting also at 6:30 the same night.

On Tuesday, Wednesday and Thursday, the exhibition will open at 9

Tentative Timetable of Technical Sessions

Chicago Convention of the A. F. A.

Monday, April 8

10:00 A. M. Exhibits Open.
Registration.
1:00 P. M. Committee Meetings.
4:00 P. M. Gray Iron and Steel Shop Operation courses.
6:30 P. M. Annual Exhibitors dinner.
Dinner—Engineering and Shop Instructors.

Tuesday, April 9

9:00 A. M. Exhibits Open.
10:00 A. M. Foundry costs.
Steel founding.
Cast iron metallurgy.
12:30 P. M. Round table luncheon and meeting on nonferrous foundry cost methods.
Round Table Luncheon and Meeting on Steel Founding.
2:00 P. M. General Foundry Practice and Management.
4:00 P. M. Gray Iron and Steel Shop Operation Courses on Sand Control Methods.
6:30 P. M. Dinner Gathering of Those Interested in Sand Control.
7:30 P. M. Sand Control.

Wednesday, April 10

9:00 A. M. Exhibits Open.
10:00 A. M. Nonferrous Foundry Practice.
Iron Foundry Practice.
Materials Handling.
12:30 P. M. Round Table Luncheon and Meeting on Nonferrous Shop Practice.
2:00 P. M. Foreman Training.
4:00 P. M. Gray Iron and Steel Foundry Shop Operation Courses.
7:00 P. M. Annual Banquet.

Thursday, April 11

9:00 A. M. Exhibits Open.
10:00 A. M. Malleable Iron.
Apprentice Training.
12:30 P. M. Round Table Luncheon and Meeting on Malleable Iron Foundry Practice.
2:00 P. M. High Test Cast Iron.
4:00 P. M. Gray Iron and Steel Shop Operation Courses.

a.m., that is one hour before the regular hour for calling the technical sessions to order. It is felt this will be a great convenience, particularly for many whose time is limited and who have to operate on a close schedule.

Three simultaneous sessions are arranged for Tuesday at 10 a.m., two luncheon meetings at 12:30 p.m., one general foundry management session at 2 p.m., another session at 4 p.m., a dinner meeting at 6 p.m. for those interested in sand control and an evening session on this and related lines commencing at 7:30 p.m. Report of the committee on molding sand research will be presented at this evening session, following the dinner.

Three sessions on Wednesday morning at 10 will be devoted respectively to nonferrous foundry practice, gray iron foundry practice and the problems involved in handling materials in the foundry. At the nonferrous session, papers will be presented by different authors dealing with pit fires, open flame and electric furnaces in their application to melting nonferrous metals. This session also will receive the report of the chairman of the division of nonferrous foundry practice.

Members attending the session on gray iron foundry practice will hear papers and discussion on cupola operation, also on investigation of defects on enameled ware castings. The chairman of the division of gray iron foundry practice will present his report at this session.

Mold handling and material handling in the foundry will be described in two papers at the third of the simultaneous sessions scheduled for Wednesday morning, starting at the same hour, 10 a. m.

Coreroom practice, part of the steel foundry operation course, will be discussed at the 4 p.m. session Wednesday. At the same hour in another room gray iron foundrymen will consider the subject of gates and risers. Where, when and how they should be placed to the best advantage, to secure the desired result and at the

(*Concluded on Page* 176)

Advance Program of Discussions

Monday, April 8

4:00 p.m.

(a) First Session: Steel Foundry Shop Operations.
Subject—*Pouring Practice.*

(b) First Session: Gray Iron Foundry Shop Operation Course.
Subject—*Cupola Control.*

Tuesday, April 9

10:00 a.m.

(a) FOUNDRY COSTS.
Practical Aspects of the Value of Foundry Cost Methods, by E. T. Runge, Cleveland.

(b) STEEL FOUNDING.
Alloy Cast Steels, by D. Zuege, Sivyer Steel Castings Co., Milwaukee.
Some Phases of Steel Foundry Operation, by E. Miltenberger, Eastern Steel Castings Co., Newark, N. J.
Efficient Steel Casting Grinding, by F. A. Lorenz, Jr., American Steel Foundries, East Chicago, Ind.
Report of Investigation of Effects of Phosphorus and Sulphur in Steel, by R. A. Bull, Electric Steel Founders Research Group, Chicago.
Report of Committee on Steel Casting.

(c) CAST IRON METALLURGY.
Quality of Pig Iron and Cast Iron as Affected by Blast Furnace Practice, by A. L. Boegehold, General Motors Corp., Detroit.

12:30 p.m.

(a) Round Table Luncheon and Meeting: Uniform Nonferrous Cost Methods.

(b) Round Table Luncheon and Meeting: Steel Foundry Practice.

2:00 p.m.

GENERAL FOUNDRY MANAGEMENT AND PRACTICE.
Use of Scrap in Gray Iron, Malleable, and Electric Steel Mixtures, by E. K. Smith and F. B. Riggan, Stockham Pipe & Fittings Co., Birmingham, Ala.
Safety and Sanitation in the Foundry, by F. H. Elam, American Steel Foundries, Chicago.

4:00 p.m.

Second Session: Steel and Gray Iron Foundry Shop Operation Course.
Subject—*Sand Control Fundamentals.*

6:00 p.m.

Dinner Meeting: For those interested in sand control.

7:30 p.m.

SAND CONTROL—Practice and Research Developments.
Review of Sand Handling Installation Problems.
THE REFRACTORINESS OF FOUNDRY SANDS, by J. F. McMahon, mines branch, dept. of mines, Ottawa, Canada.
REPORT OF COMMITTEE ON MOLDING SAND RESEARCH.

Wednesday, April 10

10:00 a.m.

(a) NONFERROUS FOUNDRY PRACTICE.
Some Practical Problems in The Brass Foundry, by H. J. Roast, National Bronze Co., Ltd., Montreal, Canada.
An Open-Flame Hearth-Type Furnace for Melting Aluminum and Its Alloys, by R. J. Anderson, G. E. Hughes, and M. B. Anderson, Fairmount Mfg. Co., Fairmount, W. Va.
Electric Arc Furnaces in General Jobbing Brass Foundry, by J. B. Meier, F. & H. Foundry Co., Newark, N. J.
Report of Chairman of Division of Nonferrous Foundry Practice.

(b) IRON FOUNDING PRACTICE.
A Study of 36-Inch Cupola Operation, by F. B. Coyle, International Nickel Co., New York City.
Some Problems of Cupola Operations, by G. S. Evans, Mathieson Alkali Works, New York City.
Investigation of Causes of Defective Castings for Enameling Ware, by C. J. Scullin, Tucker-Scullin, Inc., St. Louis.
Report of Chairman of Division of Gray Iron Foundry Practice.

(c) MATERIALS HANDLING.
Mold Handling, by R. J. Heiserman, Link-Belt Co., Philadelphia.
Materials Handling in the Foundry, by A. Walton, Philadelphia.

2:00 p.m.

FOREMAN TRAINING—A SYMPOSIUM.
The discussion of the symposium will be led by men prominent in the foreman training movement. The object of the meeting will be to show what has been accomplished when adequate training is had in foundry organizations.

4:00 p.m.

(a) Third Session: Steel Foundry Shop Operation Course.
Subject—*Core Room Practice.*

(b) Third Session: Gray Iron Foundry Shop Operation Course.
Subject—*Gates and Risers.*

Thursday, April 11

10:00 a.m.

(a) MALLEABLE IRON FOUNDRY PRACTICE.
Controlling the Atmosphere in Malleable Annealing Ovens, by W. F. Graham, Ohio Brass Co., Mansfield, Ohio.
Practical Aspects of White Fracture Malleable Iron, by Duncan Forbes, Rockford-Northwestern Malleable Corp., Rockford, Ill.
Report of Representative on Committee Advisory to Bureau of Standards, by J. B. Deisher, Rochester, N. Y.
Report of Chairman of Division of Malleable Iron Foundry Practice.

(b) APPRENTICE TRAINING.
Report of Committee on Training of Apprentices.
Why We Train Apprentices, by J. A. Davies, Westinghouse Electric & Mfg. Co., Philadelphia.
How We Train Apprentices, by A. M. Cornell, Pettibone-Mulliken Co., Chicago.

12:30 p.m.

(a) Round Table Luncheon and Meeting: Malleable Iron Foundry Practice.

2:00 p.m.

HIGH TEST CAST IRON. A SYMPOSIUM.
European Developments:
Dr. E. E. Marbaker, Mellon Institute, Pittsburgh.
Dr. Fritz Meyer, National Radiator Co., Johnstown, Pa.
American Developments:
F. B. Coyle, International Nickel Co., New York City.
R. S. McCaffery, Dept. of Metallurgy, University of Wisconsin, Madison, Wis.
R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee.
H. Bornstein, Deere & Co., Moline, Ill.

4:00 p.m.

(a) Fourth Session: Gray Iron Foundry Shop Operation Course.
Subject—*Cupola Control—Melting Operations.*

(b) Fourth Session: Steel Foundry Shop Operation Course.
Subject—*Heat Treatment of Steel Castings.*

Charging Air by Weight

Exacting Control of Air Entering the Cupola May Be Secured with a Hand Operated Gate or with Apparatus Controlled Automatically

By H. V. Crawford

BEFORE discussing the proper method of control, possibly reference should be made to the part air pressure plays in the melting operation. In some cases the practice has been to hold constant pressure on the wind box, but holding constant pressure is wrong. Resistance to the flow of air through the cupola will vary and, therefore, the pressure on the wind box should vary. Also the volume will vary according to varying temperature and barometer and the pressure on the wind box must be increased to force a greater volume through the cupola. Pressure does not bear any relation to the operation other than being the agent for forcing the proper amount of air or oxygen into the cupola. For large size cupolas additional pressure must be available to force air through tuyeres at a greater velocity to reach the center of the cupola and to overcome greater cupola resistance due to the higher charging doors. If a cold spot is forming in the center, this means that the air is passing up around the side and is not penetrating to the center and, therefore, the height of the tuyeres should be cut down.

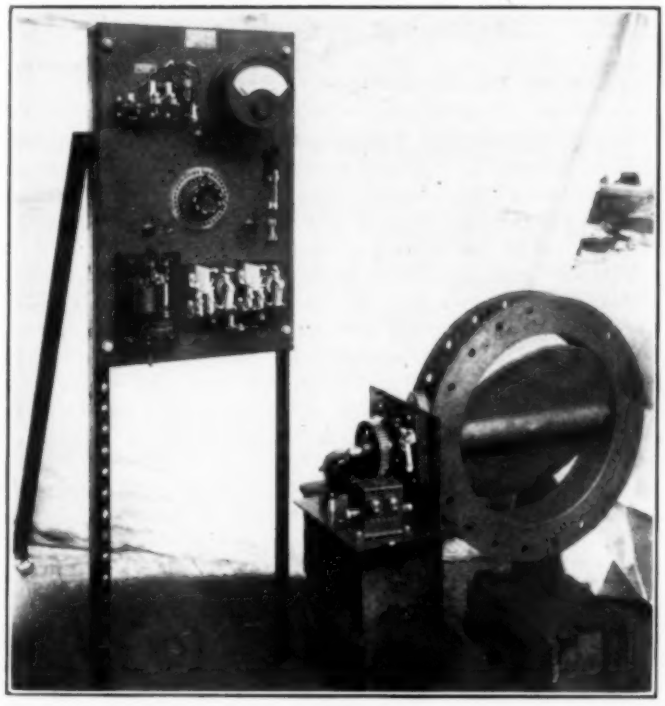
Method of Control

Since the best results in the melting operation depend on having the weight of air, iron and coke under complete control, the next step is to introduce an apparatus and a method of controlling the weight of air supplied to the cupola. Obviously, the resistance to flow of air through a cupola varies from minute to minute with the constantly changing conditions.

Electrical control device shown in the accompanying illustration Fig 2, is connected with the line supplying current to an electric motor operating a centrifugal compressor with characteristics suitable for this purpose. This control operates an artificial restriction, placed in the pipe between the blower and the cupola. This compensates for changes in cupola restriction, as well as for changes in atmospheric conditions, so as to maintain a constant weight of air flowing at all times. The mathematical theory of the operation of this apparatus will be explained later.

The control system operates on the principle that a blower and motor of suitable type have such characteristics that constant weight of air is delivered when the electrical input in kilowatts is maintained constant. The apparatus consists of a blast gate which supplies an artificial restriction in the line and is manipulated to give the motor input the desired constant value. This manipulation may be done by hand with an ordinary watt meter, and hand blast gate, or it may be done automatically by a mechanism described later and thereby eliminate the personal equation.

The apparatus is to be actuated primarily by the power input to the motor. However, in ordinary cases,



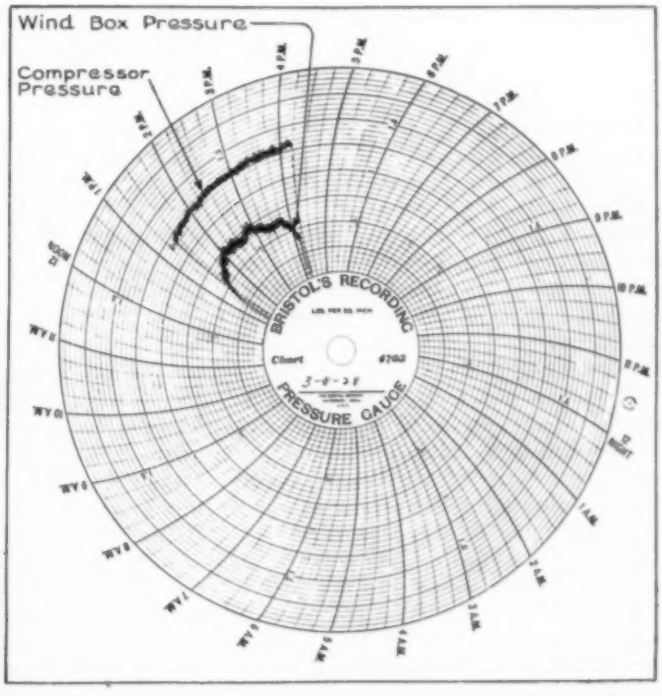


FIG. 2—AUTOMATIC GATE AND CONTROL PANEL AS IT APPEARED ON CONSTRUCTION FLOOR. FIG. 3—ONE OF THE CHARTS MADE DURING THE EXPERIMENTAL PERIOD

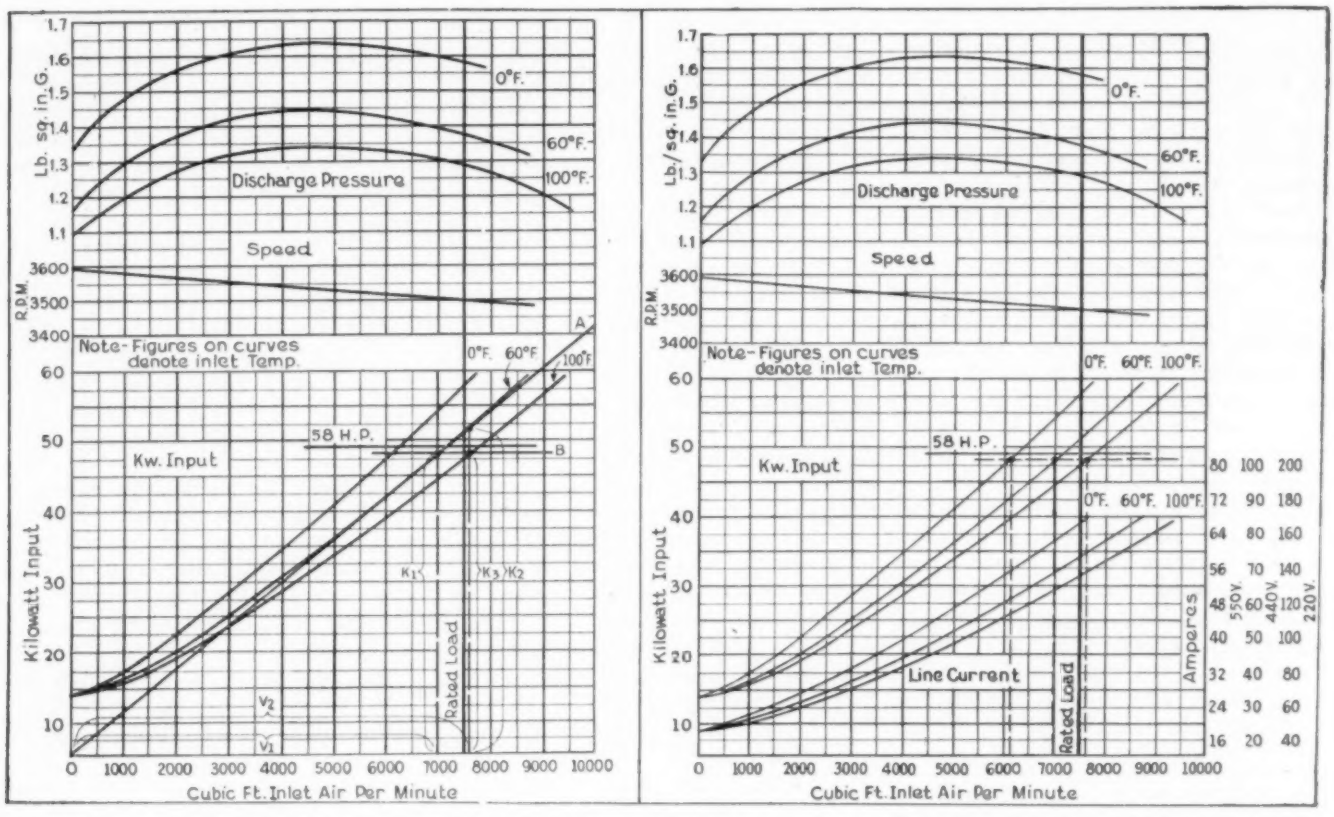
voltage is fairly constant, so that the current reading in amperes varies directly with the kilowatts input. This ampere reading may be used in most cases instead of the kilowatt reading.

Automatic control equipment, Fig. 2, consists of a reversing motor geared to a blast gate, and with a large gear ratio and provided with limit switches to prevent the gate from over-traveling and jamming. The control panel mounts an ordinary contact making ammeter with an indicating ammeter calibrated in pounds of air, switch and fuse, regulating rheostat and three standard contactors.

When the current increases slightly, contact is made and the circuit is completed through one of the contactor coils. The contactor closes and supplies power to the small motor rated at approximately 1/16 horsepower causing it to run in the proper direction to close the blast gate, bringing the current down to normal again. Likewise, when the current falls slightly, the other contactor closes, running the motor in the other direction, thereby opening the gate and bringing the current up to normal again.

The third contactor is energized all the time the blower motor is running, and power for operating the panel is supplied through its contacts. When the blower is shut down at the end of the heat, this contactor drops out and an auxiliary contact closes the power circuit to the panel, so that power flows direct to the closing contactor and the gate moves to the closed position and the limit switch on the gate breaks the circuit. This means that the blast gate is always in the closed position at starting, which gives the best starting condition and also serves to automatically close the gate and prevent the gases from the cupola backing up into the pipe line and compressor casing and thereby eliminates the probability of an explosion.

The rheostat is used to vary the reading of the ammeter so that any desired value of pounds of air can be maintained within the limits of the blower, which is approximately from 20 per cent of normal load to 20 per cent overload. The contact making ammeter arm is adjusted to the horizontal position by screws and a spring and for a given current, corresponding to the normal current on the machine, with the rheostat in approximately mid position and in parallel with the coil on the contact making ammeter the arm will float in this position with both contacts open. If the current or pounds of air value is to be increased, some of the resistance is cut out, allowing more current to flow through the rheostat and less through the current coil. This causes one of the contacts on the arm to close and the blast gate is opened wider, increasing the flow of air. The increased flow of air increases the current to a value which causes the contact to open and the arm returns to the horizontal position. The new value of current and the corresponding new weight of air are indicated on the indicating ammeter. To reduce the weight of air, the rheostat handle is turned in the opposite direction and the resistance increased. This causes the other contact on the arm to close and the gate closes and reduces the weight of air to the lower value required under the new conditions sought.



FIGS. 4 AND 5—CHARACTERISTIC CURVES OF CENTRIFUGAL COMPRESSOR RATED AT 7500 CUBIC FEET PER MINUTE, 1.25 POUNDS PER SQUARE INCH BASED ON AIR AT 14.7 POUNDS PER SQUARE INCH ABSOLUTE

Equipment is made of standard parts properly enclosed and requires no attention other than oiling of the small motor and gears probably once or twice a year.

The control equipment is only suitable for use with blowers having certain characteristics. Fig. 5 shows the characteristics of such a blower, and it can be shown from this figure that constant kilowatt input or constant current will give constant weight of air.

Figuring for a certain condition that 7000 cubic feet is required at 60 degrees Fahr. and 14.7 to give the proper weight of oxygen, when the air temperature increases to 100 degrees Fahr. this 7000 cubic feet will expand so that the volume of inlet air should be increased to get the same weight of air. The weight of the air will vary inversely with the

absolute temperature of the air, so that we have $\frac{560}{520} \times 7000 = 7550$ cubic feet of air to give the same weight. Likewise, when the air temperature drops to 0 degrees Fahr. we have $\frac{460}{520} \times 7000 = 6200$ cubic feet to give the same weight of air. This shows an increase in the volume from 0 degrees to 100 degrees of 22.0 per cent to maintain a constant weight of air.

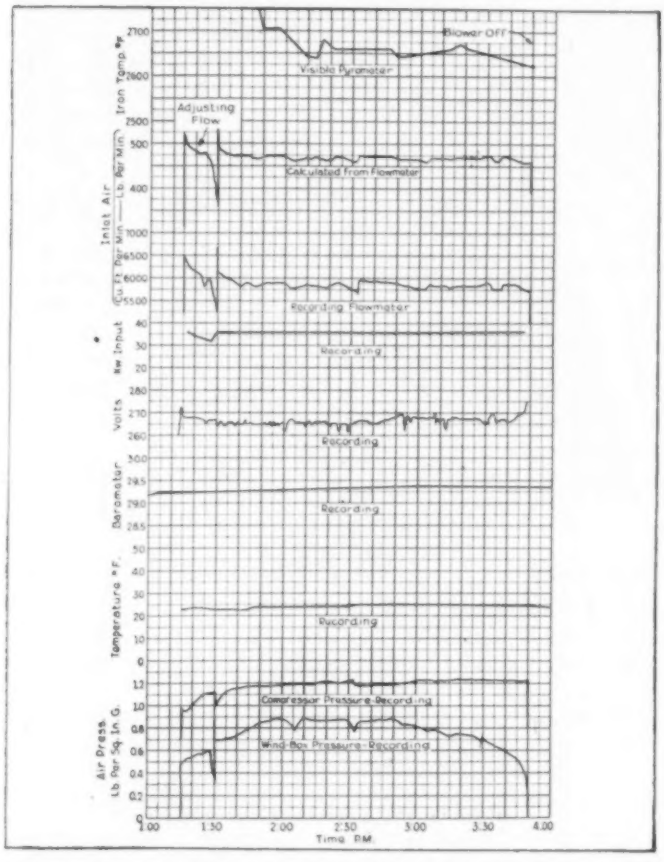
Referring again to Fig. 5 the kilowatt input for 7000 cubic feet for the 60 degree condition is 48. For 6200 at 0 degrees Fahr. the kilowatt input is also 48 and also at 7550 cubic feet at 100 degrees Fahr., the kilowatt input is 48.

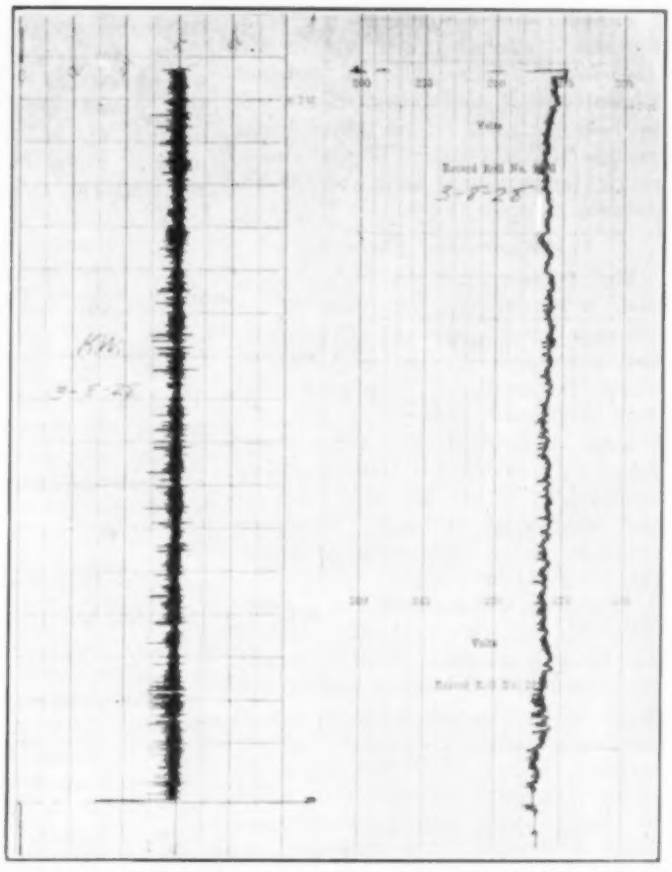
This shows conclusively that holding a constant kilowatt on a machine having characteristics of this nature, a constant weight of air will be delivered irrespective of changes in temperature, barometer or altitude, or resistance through the cupola.

As proof that this equipment will hold a constant weight of air for varying conditions tests have been made with recording instruments, but unfortunately these were not started in time to show any appreciable change in temperature. However, practical results through eight months' operation have unquestionably proved the worth of this equipment.

Fig. 6 shows results when the temperature was practically constant, and Fig. 7 shows actual charts for one day. The curves in Fig. 6 were plotted from the actual charts.

These tests were made on a direct current installation and the slight variations are due to voltage change. Supplemental information will be on the basis of tests on an alternating current equipment, where the voltage will be practically constant.





FIGS. 6 AND 7—TESTS ON CENTRIFUGAL BLOWER WITH AUTOMATIC CONTROL HOLDING CONSTANT WEIGHT OF AIR DELIVERED TO THE CUPOLA, ALSO THE KILOWATT INPUT AND VOLTAGE

The upper curve in Fig 6 shows the iron temperature taken with an optical pyrometer. The consistently high temperature of the iron for consecutive days should be noted. This is the result desired and once the proper combination of pounds of coke, iron and air is determined it can be maintained day in and day out.

There is nothing to wear on the blower, motor driven blast gate, or control. Weight of air will be maintained at all times and within close limit, and this factor which has been so hard to determine and control in the past now is controlled automatically. All the attention can be given to maintaining the coke and iron in proper relation.

When a change is made in the lining diameter of the cupola the weight of air can be changed to suit the new operating conditions. Likewise, if a different kind of coke having more or less fixed carbon is used, the weight of air easily can be figured and the equipment reset to give this amount and the best operating conditions again secured.

During any certain run if it is felt that more or less air is required immediately the equipment can be set in a few seconds to increase or decrease the weight of air as required.

The equipment furnished so far is shown in Fig. 2, but additional features can be added such as enclosing case, with lock to prevent anyone but an authorized person tampering with the control, auxiliary meter located at cupola indicating readily the weight of air being used, and a recording meter located on the panel or at the cupola to give daily records of weight of air. A two-pen recording pressure gage can be furnished showing the pressure at the compressor and in the wind box. This provides a chart similar to that shown in Fig. 3 and indicates the difference in pressure on the sides of the gate. If the curves are close, this shows that the tuyeres should be broken out with a bar to free the air passage and reduce the required wind box pressure.

In certain centrifugal compressors or blowers, driven by substantially constant speed motors, the effect of increase of volume on the electric power input and the effect of atmospheric conditions on the power input is such that the power input varies only with the weight of air. This weight is found by multiplying any existing volume by any existing density due to any existing atmospheric conditions. Such a compressor gives a given power input for a given product of volume times density, regardless of the individual values of these two factors. With such a motor-driven centrifugal compressor, the power input varies in the same ratio as the weight of air. Therefore, if operated at constant kilowatt input, the weight of air will be held constant within close limits irrespective of changes in the atmospheric temperature, barometer or resistance through the cupola.

Mathematical Theory

Fig. 4 shows the characteristics of such a blower and referring to the kilowatt input curve, it will be seen that a straight line A can be drawn which is practically coincident with this curve and passing through the origin. A curve of this shape shows that this machine will deliver a definite weight of air per unit time for each reading of wattmeter, regardless of atmospheric temperature, barometer or altitude.

Assuming for one condition a power input K_1 and a flow of cubic feet of air V_1 and a value of inlet density D_1 (at 60° Fahr.) and a second condition where the values are K_2 and V_2 and the density is the same as the original density D_1. Then, since the power curve in the region in which we are working practically coincides with a straight line through the origin, we will have—

$$\frac{K_2}{K_1} = \frac{V_2}{V_1}$$

Suppose now that at the second point the density is not the original value D_1 but has another value D_2 (at 100° Fahr.) such that the weight of air passing through the machine will be the same as the weight at the original point where the inlet volume is V_1. With constant weight, density and volume are inversely proportional, hence,

$$\frac{V_1}{V_2} = \frac{D_2}{D_1}$$

The power at the second condition when the density was D_1 had the value of K_2. If, however, the density is D_2, the power K_2 will vary directly as the density. Hence,

$$\frac{K_1}{K_2} = \frac{D_2}{D_1}$$

This is true, regardless of the efficiency or shape of efficiency curve, since we are working at a given value of inlet volume and hence at a given efficiency. It follows from the last two equations that

$$\frac{K_2}{K_2} = \frac{V_1}{V_2}$$

From the first equation, it follows that

$$\frac{K_2}{K_1} = \frac{K_2}{K_2}$$

Hence,

$$K_1 = K_2$$

Referring again to Fig 4, $V_1 = 7000$ cubic feet and $K_1 = 48$ kilowatt and D_1 is the density at 14.7 barometer and 60 degrees Fahr. temperature. At the second condition, if D_2 is the density at 14.7 barometer and 100 degrees Fahr. in order to hold constant weight, the volume will increase in the ratio of absolute temperatures, as the change in density is due to the change in temperature from 60 to 100 degrees Fahr.

$$\frac{460 + 100}{460 + 60} \times 7000 = 7550 \text{ CFM}$$

Therefore at 7550 cubic feet per minute at 100 degrees K_2 also equals 48 kilowatts or a horizontal line B can be drawn through the points where V_1 crosses the 60 degree input curve and V_2 the 100 degree curve.

Manipulates Blast Gate

It follows, therefore, that an iron foundry cupola may be provided with a constant weight of air at all times by manipulating the blast gate or throttle valve in the discharge line. The cupola pressure will vary from time to time and it is necessary in laying out a blower for an iron foundry cupola, to arrange the pressure slightly higher than would be needed for average operation, and to throttle the difference with the blast gate. Then if atmospheric conditions, density of the coke or iron, changed conditions of the tuyere, or anything else tends to increase or decrease the weight of air supply so as to change the wattmeter reading, the flow can be restored by manipulation of the gate.

Varying the opening of the blast gate simply inserts or removes restriction to the flow of air and this restriction being in series with the natural restriction through the cupola, the gate closes to add restriction when the cupola restriction drops or opens to remove the restriction as the cupola restriction increases, thereby maintaining a definite restriction in the system, so that a certain volume corresponding to a certain weight will only flow for a given condition. If the conditions of temperature or barometer change, the blast gate assumes a certain position to let the proper volume of air flow, corresponding to the same weight of air, and this position is maintained until the restriction through the cupola increases or decreases ,and it will then change again to maintain this volume constant for this condition.

This is the second and concluding instalment of Mr. Crawford's article. Part I appeared in THE FOUNDRY, Feb. 1, 1929.

British Firm Anneals Cast Iron

(*Concluded from Page* 153)

by air that first is forced through a coke fire. Cores are loaded on racks and are conveyed into and out of the ovens on lift trucks. Temperature of the ovens is regulated through pyrometer connections.

A laboratory has been operated in connection with the plant since 1913 and the equipment has been augmented from time to time as conditions seemed to warrant. The photomicrographic apparatus and the self contained apparatus for testing resisttance grids present many points of interest. Recently a permeameter has been installed for the development of a special metal for the electrical industry.

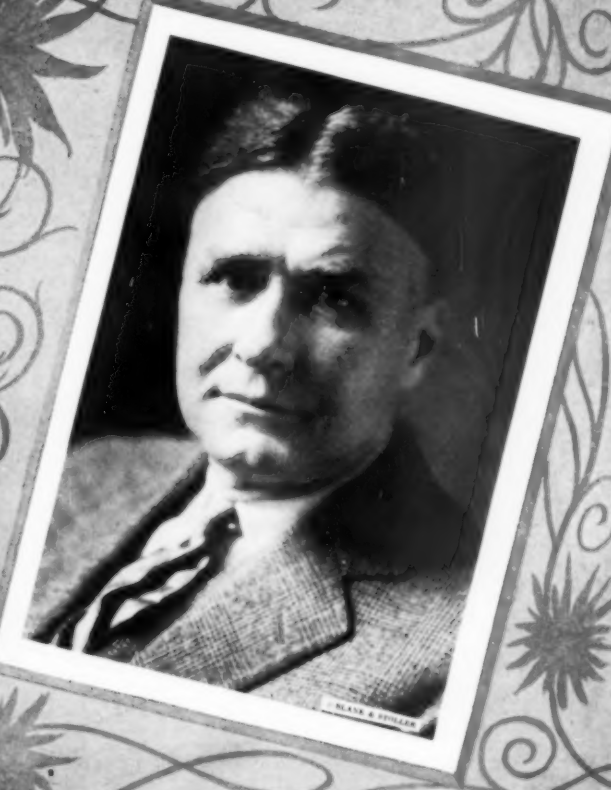
For several years the company has devoted special effort to the production of a highly permeable cast iron. Constant research on the problem still is in progress. The company also holds the licence for the production of a nonmagnetic cast iron under the Ferranti-Dawson patent 204598/20 and makes castings in any weight up to 200 pounds.

Sells Many Furnaces

The Aluminum Foundry Equipment Co., Plymouth building, Cleveland, has sold tilting type aluminum melting furnaces to the following companies: U. S. Aluminum Co., Fairfield, Conn., twenty 350 pound capacity; U. S. Aluminum Co., Cleveland, three 350 pound capacity; U. S. Aluminum Co., Cleveland, magnesium plant, five 550 pound capacity; Michigan Steel Castings Co., Detroit, one 350 pound capacity; Aluminum Co. of Canada, Ltd., Toronto, Can., one 350 pound capacity. The company also sold a brass furnace to each of the following: Lorain Casting Co., Lorain, O.; Fay & Scott, Dexter, Me., and A. L. Swett Iron Works, Medina, N. Y.

The offices of the British Perlit Iron Co., have been removed from 15 Victoria street, London, S. W. 1, to 9 Rumford street, Liverpool, Eng.

The FOUNDRY Family Photograph Album



Upper Left

J. G. PLATT
Hunt-Spiller Mfg. Corp., Boston

Lower Left

S. H. CLELAND
Eastern Clay Products Inc., Buffalo

Upper Right

F. B. COOLEY
New York Car Wheel Co., Buffalo

Lower Right

GEORGE ADAMS
Bunting Brass & Bronze Co., Toledo, O.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

RECOMMENDED HEAT TREATMENT PRACTICE

FOR CARBON STEEL CASTINGS

(Concluded from Data Sheet No. 752)

then be slowly cooled in the furnace until they reach a faint red color, after which the cooling may be continued in air.

9. To secure finer structure (with probably less ductility than can be obtained by annealing as described in Section 8) castings should be heated as described in Section 7 to one of the temperatures given in Section 5, and cooled in still air.

10. To secure fine structure, accompanied by great ductility, normalizing as described in Section 9 should be followed by a reheating and subsequent cooling. In this reheating, the castings may be kept for a short time just above the lower critical point or they may be kept for several hours at a suitable temperature below the critical range. After this reheating the castings should be cooled slowly in the furnace until they reach a faint red color (provided they reach this color in the reheating), after which the cooling may be continued in air.

11. To secure maximum refinement of the structure coupled with the greatest possible combination of strength and toughness, castings should be heated as described in Section 7 to one of the temperatures given in Section 5, and quenched in water or oil. They then should be reheated. In this reheating, the castings may be kept for a short time just above the lower critical point or they may be kept for several hours at a suitable temperature below the critical range. After this reheating the castings should be cooled slowly in the furnace until they reach a faint red color (provided that color was reached in the reheating operation), after which the cooling may be continued in air.

12. (a) Certain castings which from their mass or design would crack on quenching if kept in the water or oil until completely cold may be safely treated by removing them from the quenching bath when they have reached a black heat, immediately charging them into a furnace heated to approximately the same temperature as the castings, and reheating them as described in Section 11.

(b) The advisability of attempting to quench and reheat any given casting must be considered with judgment in the light of experience; and to attempt to apply this method of heat treatment without taking the precautions demanded by the shape, size and sections of each individual casting can only result in the loss of many castings through the development of cracks, either in quenching, in reheating, or at some later time.

SCRAP METAL SPECIFICATIONS

FOR USE IN BASIC OPEN-HEARTH FURNACES

No. 1 Heavy Melting Steel Scrap

Steel scrap ¼-inch and over in thickness, not over 18 inches in width, and not over 5 feet long will constitute No. 1 heavy melting steel scrap. Individual pieces must be cut into such shape that they will be free from attachments and will lie flat in a charging box. Cut boiler plate must be practically clean and free from stay bolts and not over 3 feet long and lie reasonably flat in charging box. Smaller dimensions of plate scrap may be required upon mutual agreement between buyer and seller. No piece to weigh less than 5 pounds.

May include structural shapes, angle bars and plates, steel castings, heavy chain, carbon tool steel, heavy forgings, forge butts, and similar heavy material.

This grade also may include new mashed pipe ends, original diameter 4 inches and over, thoroughly flattened, sheet bars, billets, blooms, rail ends, railroad steel, and wrought scrap, such as angles, splices, couplers, knuckles, short rails, drawbars, cut cast-steel bolsters, coil and leaf springs (all coil springs to be ⅝-inch or larger diameter).

No needle or skeleton plate scrap, agricultural shapes, annealing pots, boiler tubes, grate bars, cast iron, malleable iron, or curly or unwieldy pieces will be accepted.

Must be free from dirt, excessive rust or scale, or foreign material of any kind. Alloy-steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

No. 2 Melting Steel

Plate scrap, such as car sides, automobile frame stock, tank and skelp crops, ⅛-inch and heavier, steel parts of agricultural implements, wagons, buggies, and scrapped automobiles, auto and buggy springs cut apart, rods and bars, ½-inch and heavier, punchings, ¼-inch and over in thickness, heavy clippings, new unmashed pipe ends, under 4 inches in diameter, horseshoes, and similar material will constitute No. 2 melting steel. Car sides and all light plates to be sheared 15 x 15 inches or under and all tires and light rods to be 12 inches and under in length. Any curved or twisted pieces must be sheared into such shape that they will lie flat in a charging box and not tangle in handling with a magnet, all to be free from cast iron, malleable iron, burnt scrap, dirt, or foreign material of any kind.

Maximum size 15 inches x 3 feet, excepting car sides.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

Abstracted from Bulletin R58-28, bureau of standards, division of simplified practice.

(Continued on Data Sheet No. 755)

How and Why in Brass Founding

By Charles Vickers

Castings Vary in Weight

We are making a small aluminum cylinder with the upper end closed, and the lower end flanged on the outside, with walls ⅜-inch thick. The closed end carries a heavy boss or hub in its center and on top of this we place a large riser. We pour it on the bottom through a gate on the flange. As these castings must withstand an air pressure of 200 pounds we use an alloy consisting of aluminum 85 per cent; copper 3 per cent; zinc 12 per cent which is satisfactory with one exception. One casting weighed 19½ pounds, and another only 15½ pounds. Both castings were poured from the same pot and the heavier casting was the one poured last. Analysis of the metal gave the following: No. 1 casting: 0.80 per cent copper; 0.80 per cent silicon; 1.11 per cent magnesium; 2.33 per cent zinc; remainder, aluminum. The No. 2 casting contained: 5.34 per cent copper; 0.70 per cent silicon; magnesium 1.41 per cent; zinc 24.35 per cent; remainder, aluminum.

We can see only one explanation for this difference in weights of castings poured with the same metal and from the same melting pot, and that is that the metal was not properly mixed by mechanical means before it was poured. The heavier metals due to their higher specific gravity sank to the bottom of the crucible. This would take place even when the molten metal was seemingly vigorously stirred. The molten metals had time to arrange in layers. These layers simply spin around like superimposed wheels on a common axle, and only mixed with each other to a limited extent. This happens frequently in aluminum bronze. The aluminum segregates on top of the copper in the form of a hard, glassy copper-aluminum alloy containing about 23 per cent aluminum. When the metal is poured into ingots certain ingots from each heat will be glassy, the others too soft and tough. If the heat is poured into castings, the cope side will be composed of this glassy metal. The two metals will not mix even in pouring the mold or ingot. Experienced melters are aware the metal should be pumped for a short interval before the melt is stirred. This occurrence can be avoided by putting a disk of iron on the end of an iron bar and using it like the piston of a pump rising and falling in its cylinder, in this instance represented by the crucible or ladle. This action will mix any layers of metal that have arranged themselves in the order of their specific gravities. The magnesium showing is quite remarkable seeing the aluminum was "new" ingot. We must suppose that even that was scrap. However, it is highly probable that the magnesium was friendly and that it helped that alloy to hold the pressure.

We note that in making the alloy the aluminum was melted first; the zinc and the copper-aluminum hardener added, the pot pulled at 1450 degrees Fahr., the metal skimmed, stirred and poured. The metal used was No. 1, virgin aluminum, the zinc was Heheler, the copper electrolytic; the flux, chloride of zinc. All this is standard practice. We further note that when No. 12 alloy was used the weights came uniform, that when an alloy of 73 aluminum; 14½ copper and 12½ zinc was used the weights came uniform. Still, knowing how easy it is to make mistakes and get heats of metal which will not mix, even though much stirring has been done, we still are of the opinion before expressed, and suggest a trial of the pumping method.

Fine Sand for Pattern

We experience trouble in getting smooth white metal castings for patterns and match plates. We think it lies in the sand we are using for we employ the best brass and aluminum molder in our city.

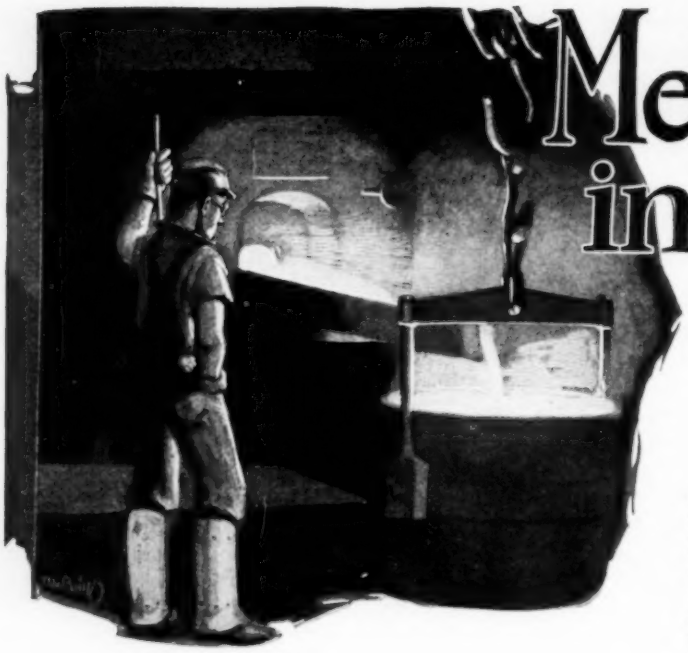
Coarse molding sand will give a rough white metal pattern. The obvious remedy is to get a couple of barrels of fine brass molding sand and fix up a sand pile for the special purpose of making white metal molds.

Sand with the general characteristics of Albany No. 00 gives good results for molding white metal consisting of the regular tin and zinc alloys, the lead base white metals, and the tin antimony series. These alloys melt at low temperatures and can be cast in very fine molding sands. We suggest keeping this sand in one of the old fashioned brass molder's tubs, so that it will not get contaminated with the regular shop sand. When not in use the sand pile must be kept in condition and never permitted to dry out. Never leave any unmixed sand in the mold dumping end of the tub. Always screen the sand through a No. 4 seive, and about once a month put it through a No. 6 seive. When the sand is screened into the working end of the tub, pat it down with the back of the shovel, and then water it. While standing, always keep it watered and ready to use. A slight sprinkling every day will accomplish this. Such a sand pile is always useful in every brass foundry. It costs nothing to keep up. Only requires small space, but when fine castings have to be made in either white metals or brass, its usefulness will be apparent.

Effect of Water Dipping

How are bronze castings affected as to hardness and softness when plunged into a bath of cold water immediately after being shaken out of the hot mold?

The effect on bronze castings is nil, as far as hardness or softness is concerned. Plunging such castings into water is a well-known method of freeing them from cores and molding sand. The method has been practiced for a century or more. It is known as *blowing out the cores* and it certainly accomplished this in an exceedingly satisfactory manner. Also the castings may be colored a pleasing gold color when the blowing out is done at the right moment. However, this coloring does not apply to scrap containing iron, sulphur aluminum, silicon and such like poisons. Even a sandblast and an acid dip has a hard time coloring such materials. In the case of some alloys the physical properties of the castings are improved by water chilling. Thus massive castings of aluminum bronze that would cool slowly in the sand, should be shaken out while red hot and cooled by water sprinkling, or by dipping. This prevents what is known as *self annealing*, which renders the alloy comparatively weak.



Melting Iron in the Cupola

Part XII

By J.E.Hurst

SOME remarkably high thermal efficiency figures obtained in a series of further tests by Piwowarsky and Meyer are shown in accompanying tables. These tests were carried out in the foundry of Sulzer Bros., Winterthur, Switzerland on a cupola equipped with a forehearth. The diameter of the cupola at the melting zone was 29 inches, expanding to 39 inches above the melting zone. The cupola was equipped with two rows of tuyeres 15.7 inches apart. Each of the eight tuyeres in the upper row was 3 inches square, each one of the four in the bottom row was 4.3 x 5.5 inches or 24 square inches area. The total tuyere area of 168 square inches gives a ratio of tuyere area to melting zone area of 1 to 3.94.

Composition of the metal used in the experiments varied between the limits of silicon content of 1 to 2.75 per cent and phosphorus content of 0.10 to 0.81 per cent. Analysis of the coke follows:

Fixed Carbon	85.62 per cent
Ash	10.49 per cent
Moisture	2.88 per cent
Sulphur	1.01 per cent

In the *Foundry Trade Journal*, April 8, 1926 Hejemana records thermal efficiencies in three tests of 20.5 per cent, 35.8 per cent and 42.3 per cent with coke consumptions of 20.5 per cent, 13.9 per cent and 10.5 per cent respectively. The heating value of the coke in these instances was 6800 calories per kilogram.

Thermal efficiencies and losses abstracted from various published balance sheets are summarized in Table IX. The wide variation in thermal efficiencies is an index of the differences already anticipated. However, the summary is useful in indicating from various investigations the magnitude of heat losses in various directions. Considering the wide variety of practical conditions represented by these tests, the agreement of the results in certain particulars is quite remarkable.

Important Factors

DESCRIPTION of German experiments on ideal melting is followed by reference to chemical reactions, efficiency under commercial conditions, coke to iron ratios, coke composition, variables in estimating melting efficiency, quantity, pressure and velocity of air, European and American studies of ideal cupola operation, penetrating power of blast, melting rate based on area, influence of tuyere dimension. A number of detailed tables show the crystallized results of long series of tests by several investigators on the general subject of thermal efficiency and cupola operation.

The two principal items constituting heat losses are the sensible and latent heat carried away by the escaping gases. Sensible heat is that contained in the escaping gases by which they are maintained at the observed temperature of exit. Latent heat is that heat which would be utilized in the cupola if the carbon monoxide which the gases contain were completely burned to carbon dioxide.

Attempts have been made to ascertain the theoretical limit of thermal efficiency that can be obtained using coke and air exactly as under commercial conditions. These theoretical considerations have been carefully examined by Thompson and Becker as a result of which they have been able to construct an equation which can be utilized in determining the theoretical limit of the thermal efficiency. With tapping temperature of the molten metal of 1425 degrees Cent., temperature of the exit gases 425 degrees Cent. and a CO/CO_2 ratio of 1 the theoretical limit of thermal efficiency is determined as 52.6 per cent of the total heat available from the coke or 49.1 per cent of the total heat input from all sources.

Thompson and Becker, *Journal*, Institute British Foundrymen, 1925-26, p. 162, clearly demonstrate that consideration of thermal efficiency of the cupola is incomplete without reference to three things: Tapping temperature of the molten metal, temperature of the escaping gases and CO/CO_2 ratio in the escaping gases. This often is overlooked in consideration of cupola efficiency.

The foundryman principally is concerned with fuel economy. For example, a conceivably high thermal efficiency coupled with a high tapping temperature is of no interest to the foundryman if the tapping temperature is higher than his requirements and is not accompanied by the most economical consumption of fuel. He desires the lowest coke consumption coupled with a tapping temperature sufficiently high for his requirements, in other words the highest coke efficiency.

Among foundrymen the most common method of expressing coke consumption is in the form of a simple ratio between amount of coke used and amount of iron melted. In spite of the more modern tendency to express this ratio as a percentage it is the simplest and the most generally understood. In whatever manner the coke consumption is expressed, little investigation is necessary to show that this apparently simple and direct prac-

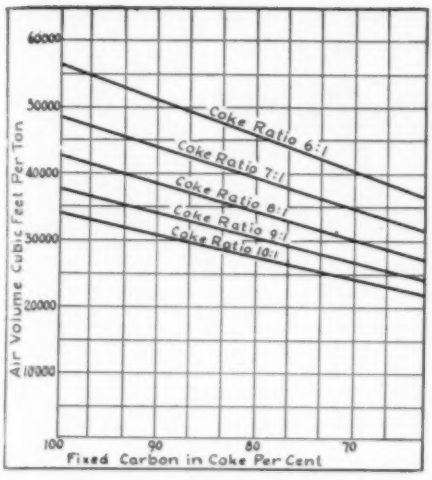


FIG. 82—AIR VOLUMES VARYING WITH FIXER CARBON IN COKE AND COKE RATIOS

tice is not the most definable of the many indefinite practices in the foundry. Many complications arise which provide some of the most controversial points in foundry discussions.

Inclusion of the bed coke in the coke ratio, formerly a contentious point, appears to be settled by general consent, and the commonly accepted coke ratio is understood to include the whole of the bed coke. Strictly speaking some of this coke is recovered from the dump, and the amount thus recovered should be deducted from the total to obtain the correct ratio. It is done in thermal efficiency investigations, but it is much too difficult and laborious a task for daily melting practice. The more modern method of dividing the total coke consumption into two items of bed coke and melting or fusion coke

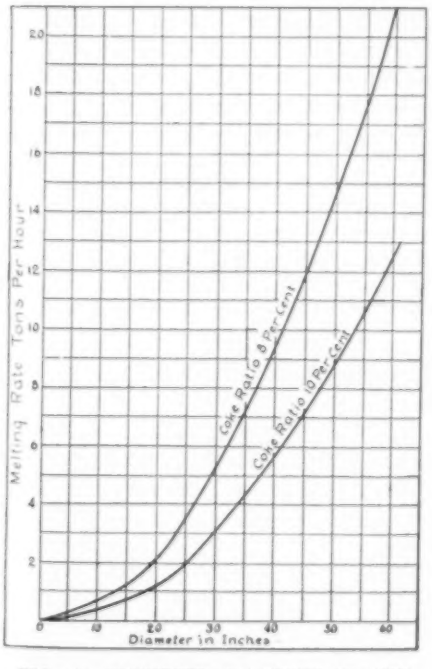


FIG. 83—DIAMETER OF CUPOLAS AND MELTING RATE

has been adopted widely. It may be expressed either as a ratio or a percentage of the iron melted whichever is more readily conceived or understood.

Considerations of coke ratio and economy often are confused by statements of the theoretical limiting coke ratio appearing in many textbooks. A typical example taken from a carefully written treatise on foundry practice follows: "The heat generated by one pound of carbon should be capable of melting about 40 pounds of iron if the combustion were complete and the absorption perfect."

This coke ratio of 1 to 40 or 2½ per cent, in spite of its careful definition with respect of the completeness of combustion and heat absorption, is based on the assumption of pure carbon as fuel and the whole of the heat evolved in the combustion being completely absorbed by the iron to be melted. To translate this into foundry practice it means that a coke ratio of 1 to 40 would be obtained using pure carbon as fuel, with the escaping gases containing no free carbon monoxide and at the same temperature as the atmosphere. Clearly these conditions do not represent conditions attainable in practice.

Presence of 12½ per cent ash in the coke, not an infrequent percentage, reduces this coke ratio to 1 to 30 with a tapping temperature of the molten metal of 1450 degrees Cent. It is impossible to burn coke in shaft furnaces without formation of some carbon monoxide. Escaping gases cannot issue from the cupola throat without carrying away some sensible heat. Additional heat of necessity must be absorbed in formation and melting of slag, in heating and radiation from the furnace lining. All these sources of heat absorption are inherent features and must be taken into consideration in determining the theoretical limit of coke ratio obtainable in cupola practice. They reduce the coke ratio to a still further lower figure.

In attempting to ascertain the theoretical limiting coke ratio it is conceivable that general agreement might be obtained on the theoretical limiting ash content of the fuel and a comparative tapping temperature. In the present state of our knowledge it is improbable that we should obtain general agreement on the limiting conditions of escaping gas composition and temperature.

However, the equation deduced by Thompson and Becker referred to previously enables us to ascertain the theoretical limit to which the coke ratio could be pushed under conditions of: (a) stipulated tapping temperature (b) escaping gas composition (c) escaping gas temperature (d) carbon content of coke and (e) heat loss by

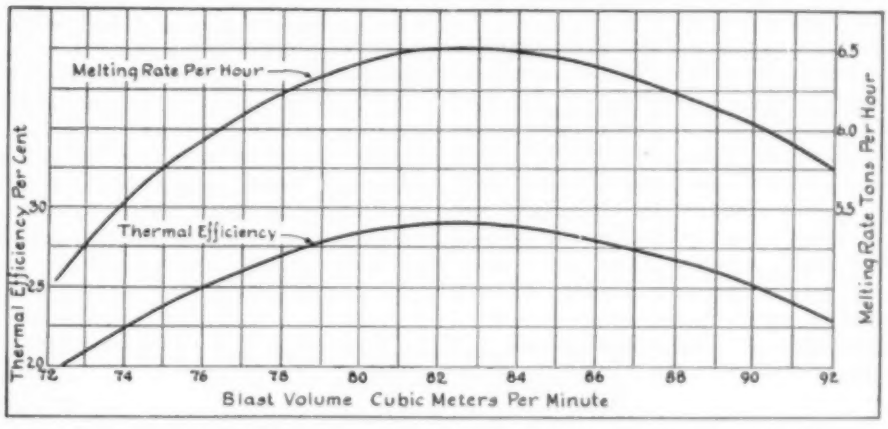


FIG. 84—CHART SHOWING BLAST VOLUME AND EFFICIENCY RELATION

way of slag, absorption by endothermic reactions, furnace lining and radiation losses.

With a tapping temperature of 1425 degrees Cent. escaping gas containing equal volumes of CO_2 and CO; escaping gas temperature of 425 degrees Cent. and coke of an ash content of 12.5 per cent the coke ratio is 15.4. Where the same tapping temperature is assumed, but the escaping gas is free from carbon monoxide and at room temperature it would be possible to obtain a ratio of 1 to 30, in other words, to melt one ton of iron with approximately 70 pounds of coke with an ash content of 12½ per cent. These values of course relate to melting coke only.

Closeness with which the foregoing theoretical limit can be approached in practice with any given coke and the same tapping temperature of the iron is determined by how close the escaping gas temperature and composition can be made to approach those specified in the limiting conditions mentioned. This is borne out by examination of heat losses in Table IX, which shows that at least 40 per cent of available heat in coke is ab-

Table VIII

Piwowarsky and Meyers Results

Test series	1	2	3	4	5	6	3	7	8	9	10
Iron charged kilos	19,210	22,630	20,438	21,130	21,320	20,970	20,438	19,220	20,160	18,720	20,010
Yield of iron Kg.	18,999	22,410	20,214	20,898	21,086	20,739	20,214	19,008	19,938	18,519	19,790
Bed coke Kg.	450	450	450	450	450	450	450	450	450	450	450
Charge coke Kg.	1,470	1,720	1,490	1,530	1,590	1,320	1,490	1,690	2,010	2,085	2,480
Coke recovered Kg.	160	115	110	80	70	117	110	268	182	273	171
Charge coke per cent per ton of iron	7.65	7.60	7.42	7.24	7.46	6.29	7.42	8.79	9.36	11.12	12.38
Total coke per cent of iron	9.25	9.08	8.96	8.99	9.24	7.88	8.96	9.74	10.51	12.08	13.79
Blast pressure ins. of water	9.8	12.2	15.7	18.1	22.8	15.7	15.7	15.7	15.7	15.7	15.7
Quantity of blast cubic feet per min.	1,260	1,588	2,118	2,259	2,647	2,118	2,118	2,118	2,118	2,118	2,118
Proportion of CO_2 to CO	76:24	74:26	86:14	74:26	78:22	88:12	86:14	73:27	66:34	62:38	60:40
Throat losses per cent of total heat input—											
Perceptible	7.21	6.61	7.39	7.68	0.64	7.05	7.39	7.74	7.71	9.23	12.23
Latent	16.45	19.7	9.48	22.34	20.7	8.64	9.48	21.06	26.60	33.26	32.44
Thermal efficiency per cent	42.0	43.8	46.7	44.4	43.2	51.3	46.7	40.7	35.1	32.9	28.8
Time of heat in minutes	376	372	265	280	275	245	264	270	310	322	370
Production tons per hour	3.20	3.61	4.58	4.48	4.61	5.08	4.58	4.23	3.86	3.45	3.21
Tapping Temperature in degrees C.											
Of iron	1,370	1,433	1,436	1,440	1,452	1,411	1,436	1,445	1,438	1,420	1,435
Of slag	1,414	1,460	1,457	1,468	1,492	1,450	1,460	1,485	1,461	1,443	1,507

sorbed in sensible and latent heat of escaping gases.

Many cupolas have been designed to minimize these particular losses and thus improve economy of the cupola. The whole problem is complicated far beyond the comparatively simple consideration of coke combustion by many other variable factors including; proportionality of height to diameter of the stack, number, shape and disposition of the tuyeres, quantity, velocity and pressure of air supply, shape of the internal lining of the cupola. In view of these complexities the only course left open in further consideration of economy of the cupola, is to consider the manner in which the operation adjusts itself in practice as determined by further experiments.

Theoretical considerations and actual experiment serve to show the importance of quantity, velocity and pressure of the air supply, the other constituent of the combustion reaction.

Quantity of air required to burn 1 pound of fuel is determined by the relation: Air required in pounds = $0.116\ [C + 3\ (H - \frac{1}{8}\ O)]$ where C., H. and O. are the respective amounts of carbon, hydrogen and oxygen in the fuel being burned in the cupola.

For cupola purposes where coke only is used as fuel, the amounts of hydrogen and oxygen can be neglected. Amount of air required to burn one pound of coke will depend upon its fixed carbon content or conversely its ash content. These values for cokes varying from 0 to 20 per cent ash are given in Table X. In accordance with the method in common use, air quantities per ton of iron melted with coke ratios varying from 1 to 10 to 1 to 6 have been included in the table and are plotted diagrammatically in Fig. 82.

Consideration of various carefully conducted trials points to the existence of a critical quantity of air supply which is accompanied by the best efficiency under given conditions of cupola design and working. Examination of the summary of results obtained by Piwowarsky and Meyer discloses existence of a critical air supply of 2118 cubic feet per minute accompanied by maximum thermal efficiency of 46.7 per cent and the maximum melting rate of 4.58 tons per hour under conditions of approximately constant coke ratio. In the further series of tests Piwowarsky and Broglio demonstrated maximum thermal efficiency and melting capacity curves coincident with a critical blast volume as illustrated in Fig. 84.

Further confirmation still is to be had from recent investigations of P. H. Wilson which clearly show the existence of the most efficient CO_2 and CO ratio coincident with critical blast volume. In all these cases the critical blast volume is slightly in excess of the theoretical quantity calculated according to the quality of coke and the coke ratio. This is clearly shown in Table XI from the calculations summarized therein.

The plan followed by Piwowarsky in determining conditions for any particular cupola occupied two stages. Operating with an approximately constant coke ratio the optimum conditions of blast quantity were determined from the determination of the thermal efficiences. In the second stage operating with this optimum blast volume the coke ratios were varied, and the low limit of 6.29 per cent was fixed apparently by the observed commencement of a decline in tapping temperature of the metal. Two of the conclusions are of sufficient interest to repeat verbatim, "(a) In each case the consequences of an

Table IX

Summary of Thermal Efficiency Tests

Thermal balance No.	(1) Heat lost by radiation from furnace lining	(2) Heat to decompose limestone	(3) Heat to Evap. moisture in coke	(4) Heat in unburnt coke	(5) Heat to raise Temp. of furnace lining	(6) Heat unaccounted for	(7) Heat to form molten slag	(8) Sensible heat lost in gases	(9) Latent heat lost in gases	(10) Heat to melt and superheat iron	(11) Thermal efficiency
1	0.18	1.84	.....	1.63	13.34	1.30	4.66	24.15	25.40	27.5	27.5
2	2.4(1)	2.0(2)	.....	0.60	.....	.....	3.7	24.6	39.0	28.5	28.5
3(3)	.....	.....	.....	.....	.....	.....	.....	7.05	8.64	51.3	51.3
4(4)	.....	.....	.....	.....	.....	.....	.....	12.23	32.44	28.8	28.8
5	.....	2.7	1.6	.....	.....	18.0(5)	4.3	.....	26.0	47.0	47.0
6	.....	.....	.....	.....	.....	16.2(6)	2.9	17.9	42.5	20.5	20.5

NOTE: (1) Probably includes other small items.
(2) Total heat from all endothermic reactions.
(3) and (4) The best and worst of Piwowarsky & Meyers results.
(5) and (6) Probably inclusive of all heat under headings not estimated.

Table X

Volume of Air Required Under Varying Conditions

Percentage fixed carbon	Air required in lbs.	Air required in cu. ft.	Air required in cubic feet per ton with coke ratios 10:1	9:1	8:1	7:1	6:1
100	11.6	152	34,048	37,720	42,560	48,638	56,746
90	10.44	137	30,600	34,150	38,400	43,750	51,000
80	9.39	123	27,552	30,613	34,440	39,360	45,920

Table XI

Comparison of Actual Critical Air and Theoretical Air Quantities

Thermal efficiency	Coke per cent	Fixed carbon per cent	Tons per hour	Actual air cu. ft./min.	Theoretical air cu. ft. /min.
46.7	8.96	85.62	4.58	2118	1999
51.3	7.88	85.62	5.08	2118	1944

excessive coke charge are more detrimental (to the thermal efficiency) than the consequences of too little air or a slight excess of air and (b) the fear that the reduction in the charge coke might cause increased losses is only founded where the charge coke is below 7 per cent."

Necessity for consideration of blast pressure arises out of need for consideration of penetration of the blast to the center of the coke charge. Steady development in the use of fan blowers in the early days caused some confusion among foundrymen in interpreting the meaning of blast pressure.

Indicated delivery pressure of fan blowers partially depends upon resistance offered to passage of air and does not necessarily indicate the effectiveness of air penetration into the charge. For this reason knowledge of volume of air delivered to the cupola per unit time becomes of increasing importance.

Importance of blast pressure in cupola practice probably depends upon the internal diameter. Under normal conditions blast pressure must give some indication of the efficiency of penetration to the center of the coke charge. Probably this is of greater importance in large than in smaller diameter cupolas and is responsible for general recommendation of an increase in blast pressure with an increase in diameter. A typical example of recommended blast pressures for increasing diameters of cupolas is given in Table XII. These recommendations are presented as typical and it will be found that the blast pressures recommended cover substantially wide range for any one given diameter of cupola. Modern tendency is toward lower pressures, provided the correct quantity of air is delivered. Pressure of air discharging under constant conditions increases as the square of the velocity and consequently lower pressure is equivalent to lower air velocities, within limits, a desirable feature. Probably penetration of air into the coke column is over emphasized even in large diameter cupolas. Lower pressures recommended are typified in Table XIII, and are expressed both in inches of water and ounces per square inch.

A more satisfactory comparison of the penetrating power of the blast is to be had by a comparison of the kinetic energy. This has the advantage of directly relating the penetrating power of the blast to its velocity. Kinetic energy of blast per cubic foot can be calculated from the formula:

$$KE = \frac{\text{(Density of blast per cubic foot) (at blast temperature and pressure)} \times \text{(Velocity)}^2 \text{ (F.P.S)}}{2 \times 32.2} \text{ foot-pounds}$$

A comparison of the penetrative force under various conditions can be made by the use of the relation:

$$\text{Penetrative force} = \frac{\text{(KE per cubic foot of blast)—pounds}}{\text{(radius of melting zone in feet)}}$$

Velocity of gases under given conditions in the cupola stack will be proportional to the volume of air delivered and to the area of free passages in the stock. This area under given conditions will be constant. Various assumed values between the limits of 0.42 to 0.25 times the cross sectional area of the cupola have been used in calculation. These values obviously depend on the character of the coke used.

Calculations on velocity of gases passing through the cupola stack vary considerably according to the value taken for the area of passages between the coke. Normal stream velocity of air delivered is increased in the passage up the stack by increase in volume of the gases due to their expansion under heat influences. Gases are claimed to expand to about 7 times their original volume and under these conditions the blast velocity is then about 100 feet per second. Other observers give values of from 100 to 110 feet per second, and recommend that to avoid further rise in velocity, the shape of the lining should be flared out to approximately 1.25 times the area at the tuyere level.

In common practice the melting rate of a cupola is related to the cross sectional area. Under normal conditions the amount of fuel consumed generally bears a simple relationship to the cross sectional area. This rule holds for all types of shaft furnaces. With blast pressures, quantities and temperatures in common use in cupolas from 1.0 to 1.1 pounds of coke are burned per square inch per hour. On the assumption of an average coke ratio of 1 to 10 this rate of burning is equivalent to a melting rate of 10 to 11 pounds per square inch cross sectional area. This basis is somewhat arbitrary but it is the common rule for determination of the nominal melting rate of cupolas. As a purely nominal rule it is quite satisfactory. It is a simple ratio to remember and bears a resemblance to similar rules in common use in general furnace construction.

Actual melting rate depends upon efficiency of generation of heat and

(*Continued on Page* 169)

Table XII

Cupola Melting Factors

Melting capacity tons per hour	Internal diameter inches	Speed of fan R.P.M.	Pressure of air inches H_2O	Horsepower
0.5 to .75	15	4800	10	1.5
0.75 to 1.25	16	4700	12	2.5
1.25 to 1.75	18	4100	12	3.75
1.75 to 2.5	20	3700	14	5.75
2.5 to 3.5	26	3200	14	7.5
3.5 to 4.75	29	2900	16	12
4.6 to 6	35	2750	16	15
7 to 9.5	41	2300	18	27
10 to 14	53	2100	18	40
13 to 17	70	1850	20	50
17 to 23	80	1675	20	66

Table XIII

Suitable Blast Pressure

Diameter inches	Ounces per square inch	Inches water
36 to 48	9	15.5
24 to 36	8	13.8
48 to 60	10	17.25

QUERIES ON FOUNDRY PRACTICE

Suggested Solutions for Common and Unique Shop Problems

Sand Mixtures for the Steel Foundry

QUERY

We shall appreciate information on the subject of the most suitable facing sand mixtures for small steel castings molded in green sand; also suitable sand mixtures for medium weight castings molded in dry sand.

ANSWER

This phase of the subject was covered in the exchange paper presented by R. A. Bull at the annual convention of the Institution of British Foundrymen in Birmingham June 13-15, 1923. The entire paper was published in THE FOUNDRY in three instalments, July 1, July 15 and Aug. 1 of the same year. Sand and sand mixtures were described in the third section. If you have access to back numbers of THE FOUNDRY we suggest you study the three sections since they cover in a brief but comprehensive manner every feature of the steel casting industry in America. *The Steel Foundry* by John Howe Hall may be ordered through THE FOUNDRY for $4. We mention these references in the event that you wish to secure a greater volume of information than possibly can be conveyed within the scope of an ordinary letter.

Local conditions to a great extent determine the most suitable sand mixture to employ. Sand deposits vary in character in different parts of the country and the freight rates are the determining factor on which is the most suitable. Satisfactory mixtures may be prepared from various combinations of silica sand and clay, and the most satisfactory for any given locality only can be found through a series of experiments. One deposit of naturally bonded sand is available in the eastern states, but a synthetic sand is employed in the great majority of steel foundries in America. The base of this mixture is silica sand ranging from 94 to 99 per cent silica.

The new sand is mixed with old sand in varying proportions from 25 to 75 per cent, depending on the character of the work and the comparative cost of the new sand. Fireclay in a finely pulverized condition is used almost universally for imparting cohesiveness to the mixture. A suitable clay has a melting point at least up to 1500 degrees Cent. Small quantities of some farinaceous product made from corn or wheat usually is added to the mixture. The mixture is wet down with molasses water or with water containing a small amount of a substitute for molasses. This material is a by-product of the wood pulp industry and is marketed under various trade names.

Its bonding strength is about one and one-half times that of molasses when used on silica sand. Practically the same material is used for green and dry sand molds. The only difference is that the bonding material is held to a minimum in the green sand facing and the sand itself is worked much dryer than it is where the mold is to be dried.

Oil Used as Core Binder

QUERY

Can you tell me what is gloss oil. Can it be used as a core binder. Can sand from the seashore be used the same as sand from the shore of a river for making cores?

ANSWER

Gloss oil is a combination of mineral oil and rosin and is used on low price paint jobs. It is mixed with the paint to secure a glossy effect usually achieved by the use of varnish. We do not know of any foundrymen using it for a core binder, but no doubt it would serve satisfactorily. Both of the ingredients, mineral oil and rosin, are used extensively as core binders either in their natural state or in combination with other materials.

Any kind of clean grain sand can be used for cores. It does not matter from what deposit it is secured or whether it is known locally as core sand, sea sand, beach sand, sharp sand, silica sand, river sand, lake sand, silver sand, parting sand, building sand or fire sand. Sand from certain deposits are more suitable than others for certain classes of cores but a discussion on that point leads too far afield. Sands containing shells are not suitable.

Chaplets a Necessity on Newel Post Cores

QUERY

In the past we have experienced considerable trouble in chipping chaplets from thin castings. They break out and leave a scar. We have some cast iron newel posts to make and we are wondering if we safely may dispense with chaplets. The metal thickness in these castings is 5/16-inch; the diameter varies with the length which ranges from 3 to 8 feet. The core extends through both ends of some castings. In others the end of the casting terminates in a ball and the core only extends through the opposite end. Can these castings be made without chaplets? What is the best method for holding the free end of the core in the mold where only one outlet is provided.

ANSWER

Your trouble in the past has been due to using chaplets that were too thick. Chaplets suitable for any class of castings may be secured from reliable manufacturers whose address may be found in the advertising pages of THE FOUNDRY. You outline your conditions and they will supply chaplets to suit them.

If you contemplate using green sand cores reinforced by heavy cast iron barrels or arbors you may dispense with chaplets, but the practice is a little tricky and only is safe in the hands of highly skilled molders accustomed to intricate green sand molding practice.

If you intend to use dry sand cores you will have to use chaplets on every casting. With good, stiff cores you may dispense with chaplets in the drag of all molds under 6 feet. In 6-foot lengths and over one chaplet will be required in the center of each core.

On the cope side one chaplet will be required for approximately every 3 feet in length. Unless the core is held rigidly it will spring under the force exerted by the fluid iron. This will result in an uneven thickness in metal in the casting and uneven thickness of metal in turn will cause the casting to warp. The *dead end* of the core will have to be held with a chaplet on each side in addition to one top and one on the bottom of the core.

Award Cash Prizes for A.F.A. Papers

Previous to the 1928 convention the board of awards of the American Foundrymen's association authorized the granting of three prizes of $100 each for papers to be presented at the convention. In reaching a decision recently announced, the judges divided the convention papers into six groups, namely, malleable, steel, gray iron, nonferrous, sand control, and general foundry practice, and one paper from each group was selected. From the six, the following were chosen as prize winners:

"Temperature Measurements of Molten Cast Iron," by H. T. Wensel and W. F. Roeser.

"The Effects of Lead on the Properties of a Complex Brass," by O. W. Ellis.

"Reducing New Sand Consumption in a Steel Foundry," by H. A. Mason.

H. T. Wensel is associate physicist and chief of the pyrometry section of the bureau of standards, Washington. W. F. Roeser is assistant physicist in the pyrometry section of the bureau of standards. O. W. Ellis is metallurgical engineer in the research department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. H. A. Mason is assistant to the superintendent of the Gould Coupler Co., Depew, N. Y.

The prizes will be presented at the 1929 convention. The board announced that similar prizes will be given for papers to be presented at the 1929 Chicago convention.

Engages Engineer

A new activity comprising a plan of shop practice consulting service, has been inaugurated by the Malleable Iron Research institute, Union Trust building, Cleveland. J. B. Deisher, Rochester, a specialist in malleable iron practice, has been engaged as a shop practice engineer for the conduct of the work. The general scope of his services, which will be given members as an added research activity of the institute, will embrace consultation and advice upon all phases of melting furnace and annealing oven practice, and of molding practice including the gating and feeding of castings to insure soundness. Sectional meetings of shop men also will be held under the direction of Mr. Deisher to discuss shop problems of general interest.

The Malleable Iron Research institute for many years had conducted laboratory and metallurgical research work under direction of its consulting engineer, Prof. Enrique Touceda, Albany, N. Y. Certificates of quality assuring integrity of castings are issued quarterly by the institute to members whose product and plant practice meet the requirements. A portion of Mr. Deisher's time will be devoted to a still more rigid inspection of castings at member plants and will give greater assurance than ever before the quality of castings shipped by plants which are awarded these certificates.

There will be no change in the conduct or scope of the institute's laboratory and general metallurgical research work which is in charge of Prof. Touceda, the consulting engineer of the institute.

Truck Manufacturers Form Association

On Jan. 1, the Industrial Truck association, composed of manufacturers of electric industrial trucks, tractors, storage batteries and accessory equipment, was formed. The association is supported by 14 companies which produce about 90 per cent of the units manufactured in the industry. These members are: Automatic Transportation Co. Inc., Buffalo; the Baker-Raulang Co., Cleveland; the Crescent Truck Co., Lebanon, Pa.; the Elwell-Parker Electric Co., Cleveland; the Lakewood Engineering Co., Cleveland; Mercury Mfg. Co., Chicago; Wright-Hibbard Industrial Electric Truck Co. Inc., Phelps, N. Y.; the Yale & Towne Mfg. Co., Stamford, Conn.; Edison Storage Battery Co., Orange, N. J.; the Electric Storage Battery Co., Philadelphia; Gould Battery Co., Depew, N. Y.; the Electric Products Co., Cleveland; the Hertner Electric Co., Cleveland; Sangamo Electric Co., Springfield, Ill. The officers of the association are as follows: M. S. Towson, Elwell-Parker Electric Co., Cleveland, president; E. J. Bartlett, Baker-Rauling Co., Cleveland and W. C. Allen, the Yale & Towne Mfg. Co., Stamford, Conn., vice presidents; G. A. Freeman, Automatic Transportation Co. Inc., Buffalo, treasurer, and C. B. Crockett, secretary. The headquarters of the new association will be 52 Vanderbilt avenue, New York city.

F. J. Tone, president, and George Rayner, vice president of the Carborundum Co., Niagara Falls, N. Y., have been elected directors of the Hutto Engineering Co. Inc., Detroit, manufacturer of cylinder grinders.

Melting Iron in the Cupola

(*Concluded from Page* 167)

efficiency of transmission of this heat to metal constituting the charge. An extension of the simple rule has been devised in which the melting rate is related to the coke efficiency. This rule is expressed in the formula derived as follows, where M = the melting rate in tons per hour; D = the diameter of the cupola in inches; P = the percentage of coke to iron by weight. Then

$$M = \frac{11\ D^2 \times 1 \times 100}{4 \times P \times 2240}$$

$$= \frac{D^2 \times 100}{2851 \times P}$$

$$= \frac{0.0351 \times D^2}{P}$$

In his experiments many years ago F. J. Cook considered the observed melting rate in relation to the cupola diameter. He defined the maximum successful melting rate as the rate of melting unaccompanied by oxidation. The diagram Fig. 83, is plotted from the former relation and at a glance shows nominal melting rates for various diameters and coke ratios.

Extensive experiments of Piwowarsky and his collaborators demonstrate that the maximum melting rate is coincident with the maximum thermal efficiency as shown in Fig. 84.

Aluminum Firms Merge

The Monarch Aluminum Ware Co., 4613 Payne avenue, Cleveland, has completed negotiations to sell a half interest in its business to the Club Aluminum Utensil Co., Chicago. The Monarch company manufactures castings for cooking utensils, automobiles, washing machines and vacuum cleaners. The officers of the Monarch Co. are Adolphe S. Deutsch, president, Harold J. Deutsch, vice president, and Raymond Deutsch, treasurer.

Ray Hunter, for many years New England representative of Wm. White & Bro., Philadelphia, has taken over the agency in the same territory for Werner G. Smith Co., Cleveland, and the Sterling Wheelbarrow Co., Milwaukee, left vacant by the promotion of L. P. Robinson to the position of general sales manager of the Werner G. Smith Co., with headquarters in Cleveland.

Readers Comment

TO THE EDITORS:

A great deal of discussion about the gray iron industry and the cause of its decay has appeared from time to time in your magazine. Personal experience during the past 8 years has shown me at least one of the causes. Before touching on that experience let me review the situation briefly.

Formerly the small brass foundry was in the position the average gray iron jobbing shop finds itself today. What did the owners do? Hold meetings like the gray iron men are doing now to bewail their hard luck to each other and to the public? No. They dug in and helped themselves. They put in molding machines and—here is the significant feature—they operated the machines to capacity. The molder did nothing but make the molds. A helper placed them on the floor, poured them and shook them out. Production in brass and aluminum in some instances has jumped to 300 molds a day. Brass foundries now are taking work that formerly was made in iron particularly in the handling and electric field.

Steel and malleable foundries use the same system on a larger scale. Only the larger gray iron foundries, those catering particularly to the automotive trade are equipped to operate in this manner. I know of foundries that last year had some automobile cylinders to make and they installed new machines for the purpose. They had to do it to compete with other shops on the job.

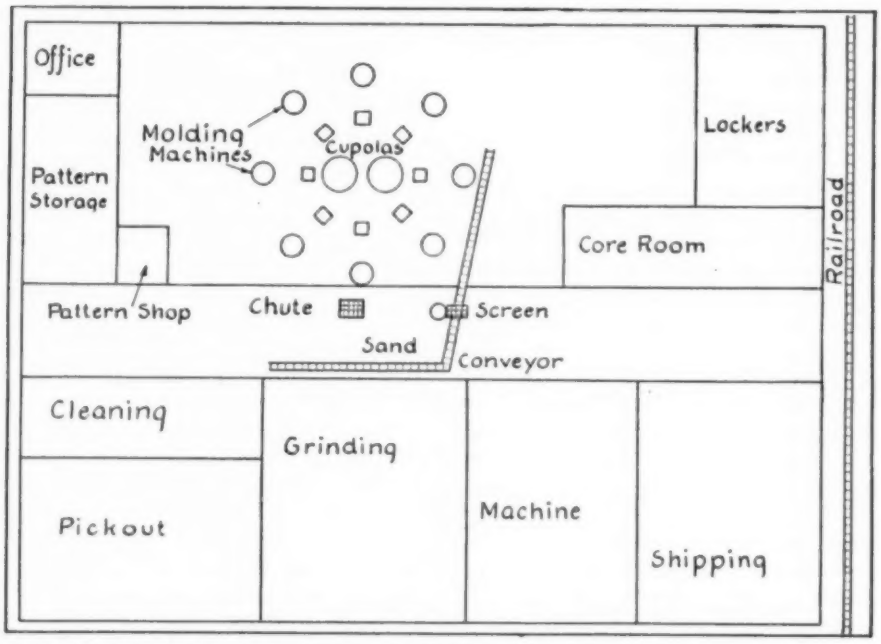
In April 1920 I was called to a foundry to install equipment and operate molding machines which at that time were new in the territory. Later I was appointed superintendent of the foundry where I had charge of the hand foundry, machine foundry, core shop, cleaning room with a total force of about 100 men for a salary of $3150 a year, $60 a week.

I worked 10 hours a day normally but had to go out at night to do jobs and also hire men, sometimes putting in 65 hours a week. In this town the bricklayers are paid $66 for a 44-hour week. Piece work operators in another line average $85 for a 55-hour week.

We hear that the quality of the iron must be improved. It is not quality but quantity that is needed. Have you heard or read of any interested party offering a prize for a solution of the problem? Neither have I. The owners of the plant in which I was employed invited me to a dinner and then were offended because I would not get up and tell the assembled guests how to make the business pay dividends. They wanted a $3000-a-year-man to give them a $15,000-a-year man's advice. Also, if I had given the opinion I have expressed here, I would have lasted on the job just about one minute.

I am attaching a proposed layout for a small foundry corresponding in size and capacity to those which are making all the fuss about unfavorable conditions. Opposition may be expected to the installation of this layout. The help at present is under paid. With this layout worked properly the men should earn from $9 to $10 a day and both men and owners would be satisfied. Installation and operation should be placed under a competent man, that is a man who actually is familiar with this method of operating a foundry.

FOUNDRY SUPERINTENDENT



PROPOSED LAYOUT FOR JOBBING GRAY IRON FOUNDRY WITH THE MOLDING MACHINES ARRANGED IN A CIRCLE, SHAKEOUT GRATINGS IN A SMALLER CIRCLE AND WITH THE CUPOLAS IN THE CENTER

Concrete Floors Are Bad

TO THE EDITORS:

In a recent issue of THE FOUNDRY the statement was made that concrete floors are satisfactory for foundry use. I cannot endorse that statement. Many foundrymen, particularly molders, lose time on account of having to work on one of these hard floors. Frequently when the foreman inquires why this or that man has not reported for duty, he is told that the absentee is a victim of rheumatism. As a plain matter of fact the man has been knocked bow-legged by the lack of resiliency in the concrete floor and is not suffering from rheumatism. In an experience covering nearly 40 years in the foundry I know of nothing that will cripple a man so quickly as a concrete floor. This is particularly true of men who work in front of a bench.

The foregoing constitutes one objection to the concrete floor. Another is the way it acts when molten iron is spilled over it. If you want to see fireworks, just stick around while a flood of iron pours from a defective mold, or from a hole burned through the bottom of a ladle or through any one of the accidents that turn up in the day's work. Every man is playing safety first for the door or for long distance. I have a few scars traceable to the concrete floor and only for a streak of luck I now would be peeping out of one eye instead of two.

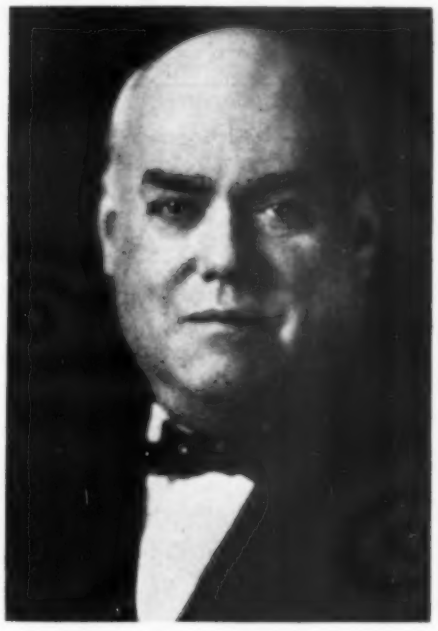
Any foundryman who wants maximum production from steady men will be well advised to install a wood block floor all over the foundry. Don't take my word for it. Take out your watch and see how long you can stand on a concrete floor with comfort. Then time yourself on a wood-block floor. Stand by the time clock some night and watch your men going out. Hump backed, spavined, all in at 35 and all due to heavy lifting on a concrete floor. Young men who enter the foundry willingly to learn the trade, quit after a few month's experience on a hard floor. They don't mind the work, but they can't stand the protest from their feet.

Matt J. Schafer.

Los Angeles, Calif.

Raised Near a Blast Furnace

HE KNOWS HIS IRONS



Spent Several Years on the Wing

GO DIRECTLY to the source, the fountain head when you want real inside information on any subject. This has been a life time motto of J. M. Hollowell, vice president and general manager of the Spalding Foundry Co., Atlanta, Ga.

Life time? You inquire, with delicately lifted eyebrow.

Drop it, boy. Drop it. Life time is right!

He began these little journeys to fountain heads and so forth, just after he learned to walk, diligently prowling around a charcoal blast furnace where his father was superintendent. He wanted to know all about iron and in all fairness what more logical place could he select than the place where the stuff is made?

Later he learned the molder's trade, became what those entertaining gentlemen Moran and Mack describe as *de haid man* in the foundry where he had and has to decide on the character of iron required to meet the varied requirements of a multitude of exacting users of castings.

He attended school and played around the furnace until he was 12—maybe it was the other way around—anyway, he sucked up knowledge in both places to such an extent that his father suggested he should learn a trade and then later with a more mature mind, go back again to the halls of learning if he was so minded. At that time he was a sturdy, strong, self reliant boy, easily able to hold his own with any of his contemporaries. The idea appealed to him and he served the regulation apprenticeship period of four years.

At the age of 16 he had acquired a good, practical knowledge of the trade and had developed a body and limbs strongly resembling those of a Greek wrestler. He still has both although as might be expected they have mellowed and—er—increased with the passing years. Long since he has occupied the position of master foundryman. Also 'tis said he practically has no rivals in sartorial elegance when he dons the smooth fitting evening clothes for a formal occasion.

He went through the University of Alabama with the class of 1890 and specialized for two years in civil and mining engineering. A windfall of $50 earned in a prize contest, provided an excuse to hit the road after the manner of the touring molders with whom he had come in contact and of whom he had heard in his apprenticeship days. He spent several years, as you might say, on the wing, and picked up a great deal of miscellaneous information on foundry practice—and other subjects. Also he developed to a marked extent the virtues of self-confidence and poise that have stood him in good stead in controlling the growth and operation of the plant in which he has been interested since 1904.

Statistics compiled by our indefatigable and infallible southern representative—which is equivalent to saying, statistics as *are* statistics—indicate that Jim arrived at the home of J. F. and Frances Rallison Hollowell on Jan. 9, 1870. This home was in Autauga county, Ala., where Hollowell Sr., was superintendent of the Shelby furnace. The young stranger arrived without hand baggage or documentary credentials of any kind. He simply opened his sparkling black eyes, calmly and leisurely appraised the situation and then announced his intention of remaining—indefinitely. What is more to the point the engaging little rascal got away with his high handed and autocratic proposal. The same engaging frankness, the same bluff and hearty manner, the same steady black eyes have been never failing magnets from that day to this in making friends and keeping them.

A craving for knowledge and a nice taste for reading in his youth have been cultivated and expanded over a wide field with the passing years. This in turn has enabled him from time to time to enjoy one of his pet hobbies, writing for the technical press and other publications including THE FOUNDRY, *Hot Blast, Montgomery Advertiser, Alabama Mirror, Piedmont Inquirer, Chattanooga Tradesman, The Age of Steel*, etc.

He dabbles discreetly to some extent in politics, partly for pleasure but principally as a friendly gesture to those needing assistance. As a nimble little wire puller it is claimed Jim practically has nothing further to learn.

Step up to any intelligent looking man on Peachtree street, Atlanta, and ask him if he knows James Meredith Hollowell, vice president and general manager of the Spalding Foundry Co., and in ten cases out of a possible ten he will say: "Who, Jim?" Then he will turn to any person standing by and remark incredulously: "What do you know o' that! Here's a guy askin' if I know Jim Hollowell!" Turning again to you he will continue: "Say fella, where yo' come from? Eve'ybody knows Jim!"

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
EDWIN BREMER, Metallurgical Editor
FRANK G. STEINEBACH, Managing Editor
CHARLES VICKERS, Nonferrous Editor
NORMAN F. HINDLE, Assistant Editor

¶ Two Costly Words

IF SOME highly skilled brain specialist could by a simple operation remove the tissues that control a person's memory for certain words, a job could be found for that doctor in the foundry industry. He could be kept busy for the next few years applying the scalpel to the brains of castings salesmen. If he could remove all trace of the ability to recall and pronounce the words *REVISE* and *REFIGURE*, the jobbing castings' business of the country would benefit beyond measure.

LACKING the services of such a super-surgeon, perhaps the management might insert a few inhibitions that would cut down the repetition of these two words that prove so detrimental to making a profit in the foundry business. To be effective such inhibition might be translated briefly, "If you revise a price, you're fired." This should admit of no argument. It should be the final dictum to every salesman of castings.

THEN for the proprietor himself, who advances every bid with a string to it. Although his quotation may not bear the words, he implies by every deed and action that if someone will only give him half a chance, he will *REFIGURE*, which in plain terms means, cut the price. Lacking the boss to tell him that he *shall not*, his cure will have to await the slower, but no less sure process of business failure. But if he will, himself, abandon the two words mentioned, with all that they imply, his condition will improve. Furthermore, he will save the entire price structure of his district from contamination.

¶ Go to Chicago

CHICAGO, April 11 to 18, should be marked upon the calendar of every progressive foundryman. The convention and exhibition, planned by the American Foundrymen's association offer exceptional opportunities to the man who wishes to keep abreast of technical, operating and business problems of the foundry industry. A complete program of papers, designed to encourage the interchange of ideas, will be supplemented by roundtables and short instruction courses that will render this convention unique. Foundry executives, including most certainly all the men in charge of operation, should be present. They will profit personally through knowledge acquired, and their firms will benefit to even greater extent by the lessons which they learn. Furthermore, this occasion will mark the first exhibition of foundry equipment and supplies in the midwest since 1926, and much progress has been made in the past three years.

¶ Bet Their Opponents Chips

USUALLY, in playing the great American game, practised prior to the introduction of that indoor pastime, known as bridge, each contestant pushed forward the little blue or red counters from his own pile. It would have been distinctly ill mannered for him to reach across and ante from his opponent's slender stack.

AUTOMOTIVE manufacturers, although many of them have risen since the good old days of poker, probably would agree that betting another man's money is not good form. However, in some of their business practices, they do not draw the line so closely nor deal so ethically with those from whom they buy. Consider the practice of ordering a large tonnage of automotive castings, against which *specifications* are issued from time to time through the year as the production of finished cars demands.

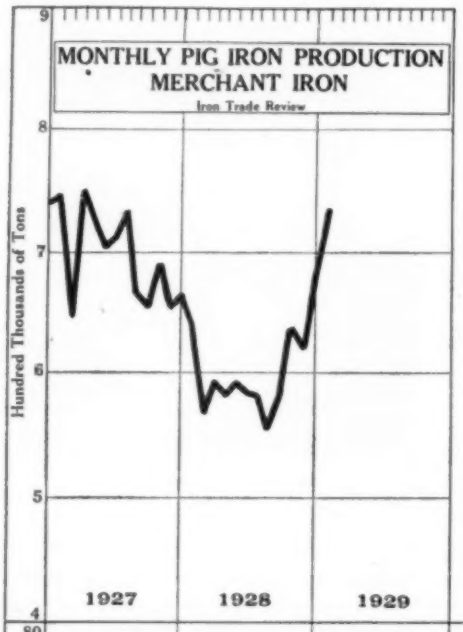
THE manufacturer insists that the foundry shall maintain a stock of castings ready for shipment upon instant demand to supply the factory as the production schedule is advanced. This means that the foundry must tie up capital, in the form of material, time and overhead, which is not returned until the thirty or sixty day period after the stock castings are in the automobile plant. Isn't this really doing business, on the supplier's capital? Are not the automotive firms betting the foundrymen's chips? Should not the castings bear a price item to offset this capital charge? We believe they *should*.

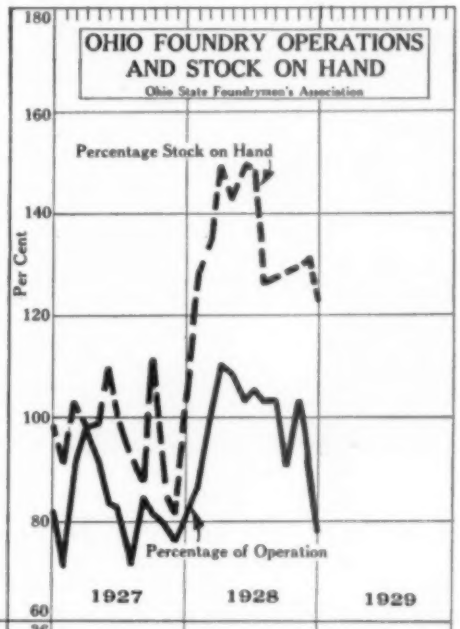
Trade Trends in Tabloid

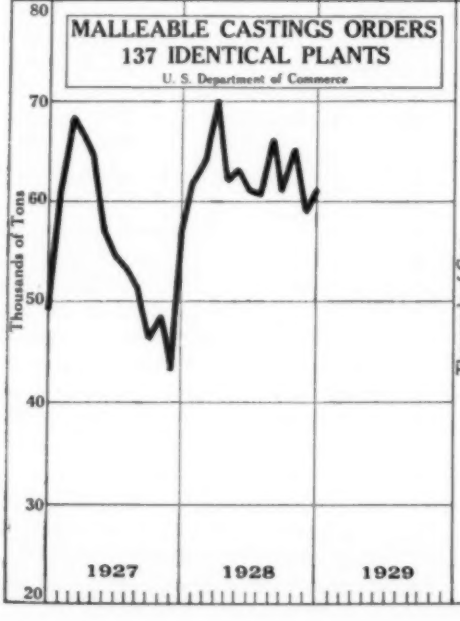
FOUNDRY melt has continued to increase during January, as reflected by direct reports and by the demand for iron. Many shops have closed on second quarter pig iron requirements. Radiator and furnace makers are busy throughout the central west. Iron foundries in the Philadelphia district showed a slight recession in output during December, which has been compensated by a pickup in January. The automotive industry has entered the new year with the highest production schedules on record, in the hope of topping the 1928 record of 4,650,000 cars and trucks. Foundry operations in Ohio, according to E. F. Scott, secretary-manager of the Ohio Foundries Association, Inc., are satisfactory. The *Iron Trade Review* in its statistical summary reports a total pig iron production of 3,432,832 tons for January as compared with 3,369,784 tons in December, 1928. The daily average rate of 110,736 tons is greater than that shown by any month during the past year. Merchant iron totaled 736,078 tons, compared with 686,431 tons for December. Six merchant stacks were lighted and two blown out. Average New York nonferrous metal prices during January according to *Daily Metal Trade* were as follows: Casting copper, 16.510c; electrolytic copper, 16.822c; Straits tin, 49.151c; lead, 6.650c; antimony, 9.567c; aluminum 23.90c. Zinc averaged 6.350c, in E. St. Louis, Ill., markets.

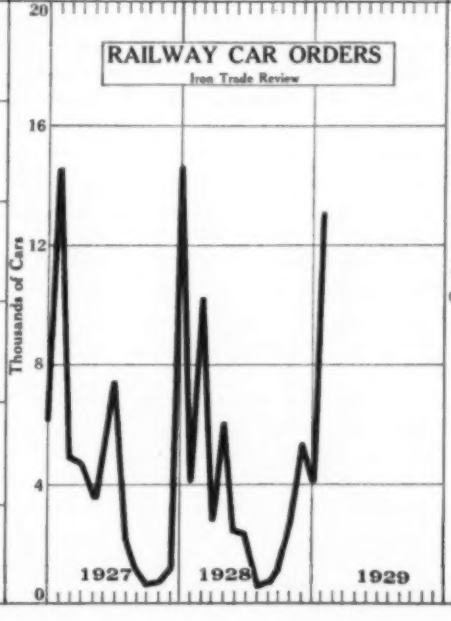
RAW MATERIAL PRICES
Feb. 6, 1929

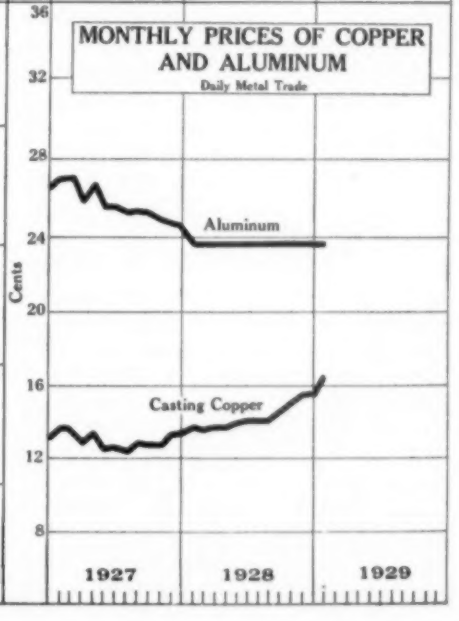
Iron	
No. 2 foundry, Valley	$17.50
No. 2 southern, Birmingham	16.50 to 17.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	18.50
Basic, Valley	17.50
Basic, Buffalo	17.50
Malleable, Chicago	20.00
Malleable, Buffalo	19.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.50 to 5.25
Scrap	
Heavy melting steel, Valley	$18.00 to 18.50
Heavy melting steel, Pitts	18.50 to 19.00
Heavy melting steel, Chicago	16.00 to 16.50
Stove plate, Buffalo	14.50
Stove plate, Chicago	12.75 to 13.25
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	16.00 to 16.50
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	16.00
Car wheels, iron, Pittsburgh	16.00 to 16.50
Car wheels, iron, Chicago	14.50 to 15.00
Railroad malleable, Chicago	20.00
Agricultural mal., Chicago	15.50 to 16.00
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	Cents per pound
Casting, copper, refinery	17.25
Electro, copper, producers	17.50
Straits tin	50.37½
Lead, New York	6.65
Antimony, New York	9.62½ to 9.75
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.50 to 17.00
Zinc, East St. Louis, Ill.	6.35











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

WILLIAM J. CORBETT has resigned as secretary-manager of the Steel Founders' Society of America to become assistant to the president of the Fort Pitt Steel Casting Co., McKeesport, Pa. Mr. Corbett is a prominent steel foundryman and one of the best-known in the country, having gained a national reputation as a result of his work in the industry. He was graduated from Carnegie Institute of Technology in 1914 with the degree of bachelor of science in mining engineering, and later received the professional degree of metallurgical engineer. His first employment was as a special apprentice at the Alliance works of the American Steel Foundries, a year later being transferred to the Chester works of the same company and held the position of production engineer at the time he resigned to accept a commission in the United States army in 1917. After demobilization of the armed forces, Mr. Corbett was placed in charge of the manufacture of castings at Watertown arsenal until the latter part of 1919, when he again became affiliated with the American Steel Foundries as assistant to the fourth vice president with headquarters in Chicago. In 1923 he became industrial engineer for the Electric Steel Founders' Research group, which is composed of five electric steel foundries and which was organized in 1920 to conduct co-operative research work in the various phases of the manufacture of steel castings. When the scope of the activities of the Steel Founders' Society of America was enlarged in 1925, the services of Mr. Corbett were secured and he has been secretary-manager since that time. He has been active on numerous committees of the American Foundrymen's association and the American Society for Testing Materials, among them the joint committee for the investigation of the effect of sulphur and phosphorus in steel, the joint committee on pattern equipment standardization, and the joint committee on molding sand.

WILLIAM J. CORBETT

Harry R. Howell, formerly foundry superintendent, Superior Foundry Co., Cleveland, has taken a similar position with the Paxton-Mitchell Co., Omaha, Neb. Prior to his association with the Superior Foundry Co. he was foundry superintendent of the Ryan-Bohn Foundry, Lansing, Mich.

A. H. Jameson, sales manager, Deemer Steel Casting Co., New Castle, Del., has resigned, effective March 15, to become manager of castings sales for the Malleable Iron Fittings Co., Branford, Conn. Mr. Jameson formerly was connected with the company to which he is returning.

Frank R. Hastie, formerly manager of the Springfield, Mass., branch of the American Radiator Co., has been named manager of its Worcester, Mass., sales office. Mr. Hastie has been with the company since 1913, originally at the Providence, R. I., office. He more recently has been sales supervisor of the New England branch at Boston.

G. H. Austin, of the American Steel Foundries, Hammond, Ind., was elected president of the Hammond Manufacturers' association, at a recent meeting.

O. W. Ellis, metallurgist, Pittsburgh, has been designated to take charge of the metallurgical research work to be undertaken by the recently organized Ontario Research foundation, Toronto, Ont. He formerly was connected with Westinghouse Electric & Mfg. Co., Pittsburgh.

J. B. Deisher, Rochester, N. Y., has been engaged by the Malleable Iron Research institute, Cleveland, to act as shop practice engineer, and will in the future devote all of his time to Malleable Institute activities. Prior to Mr. Deisher's work as an independent foundry consultant, he was for 14 years connected with the Symington Co., Rochester, N. Y.; for 3½ years served with the American Malleable Castings association and Malleable Iron Research institute as assistant to the consulting engineer; and in 1927 was sent to Europe by the American Radiator Co. as consulting engineer in its French malleable plant located in a suburb of Paris. He was one of the pioneers in the use of pulverized coal in the air furnace for melting malleable cast iron and has since had an active part in the development of this method of firing. Mr. Deisher also represents the American Foundrymen's association, for the malleable industry, on an advisory committee to the bureau of standards, department of commerce, Washington.

JOSEPH B. DEISHER

John A. Smeeton, M. I., Mech. E., has resigned his position as managing director of the British Perlit Iron Co. Ltd., 15 Victoria street, London,

S. W. 1. He will remain a director of the company.

David McLain, McLain System, Inc., Milwaukee, will address the St. Louis Foundry club Feb. 19.

Alexander V. Mueller has resigned as chief engineer of the Kingsford Foundry & Machine Works, Oswego, N. Y., to become associated with a pump manufacturer at Salem, O.

William P. Gargan has been appointed chief engineer of the Kingsford Foundry & Machine Works, Oswego, N. Y. He joined the Kingsford organization three years ago, previously having been identified with Goulds Pumps Inc., Seneca Falls, N. Y.

H. E. Melin has resigned as chief engineer of the Youngstown Foundry & Machine Co., Youngstown, O., to join the sales organization of the Aetna-Standard Engineering Co., Youngstown, O. Mr. Melin was graduated from Chalmers university, Gothenburg, Sweden, and formerly was associated with the Youngstown Sheet & Tube Co.

H. L. Sanders has been elected president of the Cincinnati Car Corp., Cincinnati, which recently was formed to take over the manufacturing properties of the Cincinnati Car Co., and the Versare Corp., Albany, N. Y. Other officers of the company are: A. L. Kasemeier, J. H. Elliott and O. F. Warhaus, vice presidents; E. C. Bernhold, secretary-treasurer and S. E. Reiph, assistant secretary-treasurer.

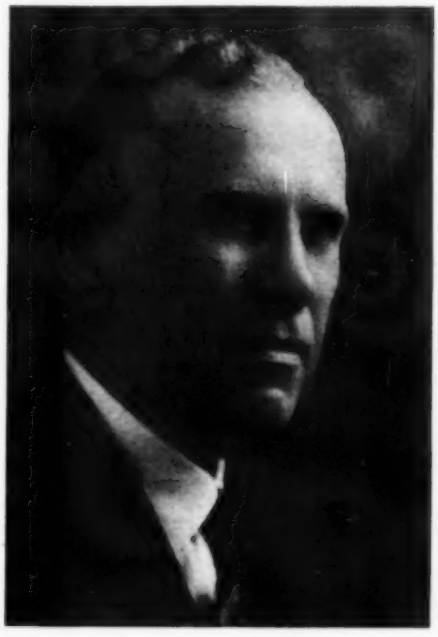
John E. Perry, formerly president of the Valley Mould & Iron Corp., Hubbard, O., recently elected chairman of the board of directors. Mr. Perry has been president of the company since March 1, 1918. Previously he was president of the Wharton Steel Co., Wharton, N. J., and prior to that assistant to the president of the Republic Iron & Steel Co.

William Haig Ramage, formerly vice president of the Valley Mould & Iron Corp., Hubbard, O., has been elected president of the company. For the past six years he has devoted himself to matters of operating, service and design. He was graduated from Phillips academy, Exeter, N. H., and Cornell university, Ithaca, N. Y. After graduation he entered the anthracite coal industry for a brief period. Later he entered the iron and steel industry and was active both in construction and in operating capacities. For several years prior to his connection with the Valley Mould & Iron Corp. he was chief engineer for the Briar Hill Steel Co., Youngstown, which was acquired by the Youngstown Sheet & Tube Co. in 1923.

Fred H. Marsh and John H. Merz recently were added to the board of directors of the Paxton & Vierling Iron Works, Omaha, Nebr., at the company's forty-third annual meeting. The following officers were re-elected: President, A. J. Vierling; treasurer, B. J. Scannell, and secretary, F. R. Vierling.

Mont Murray, formerly president of the Keystone Bronze Co., Pittsburgh, recently became affiliated with the General Bronze Co., Pittsburgh, as chairman of the board of directors.

Samuel M. Phillips, formerly manager of the Stewart Furnace Co., Sharon, Pa., has been elected vice president and general manager of the Valley Mould & Iron Corp., Hubbard, O. Mr. Phillips attended Cornell university and became identified with the Stewart Furnace Co. in 1909. In 1922 he was made assistant general manager and in 1924 was promoted to general manager of the company.



DR. H. P. EVANS

F. J. Hemming, joint managing director, F. H. Lloyd & Co. Ltd., operating the James Bridge Steel Works, Wednesbury, Eng., is in the United States to investigate American foundry methods and equipment. F. H. Lloyd & Co. Ltd. operates a steel foundry making converter castings and heavy acid open-hearth steel castings.

E. F. Baker, president of the Kewanee Boiler Co., Kewanee, Ill., has been elected a director of the American Radiator Co., N. Y.

J. L. Patterson has been appointed manager of the Buffalo plant of the United States Aluminum Co.

H. A. Pratt has been elected assistant general manager of Wilcox, Crittenden & Co., Middletown, Conn.

A. L. Foster has been re-elected a member of the board of directors of the Galion Iron Works & Mfg. Co., Galion, O.

H. J. Stein recently resigned his position with the Ornamental Brass Shops, Rockford, Ill., to become affiliated with the Allis-Chalmers Mfg. Co., West Allis, Wis.

Chicago Club Names Officers for 1929

Officers elected by the Chicago Foundrymen's club, to serve for 1929, are: President, Dr. H. P. Evans, director of metallurgical research, Pettibone Mulliken Co., Chicago; and vice president, R. E. Kennedy, technical secretary of the American Foundrymen's Association. A. N. Wallin, of the S. Obermayer Co., Chicago, will continue as secretary.

The officers were presented at a meeting of the club Thursday evening, Feb. 7, following a dinner and entertainment. Charles J. Scullin, St. Louis, consulting metallurgical engineer and practical foundryman, addressed the meeting on the operating phases of cupola practice.

David G. Anderson, chief of foundry development engineers, Western Electric Co., Chicago, who has served two terms as president, presented a short survey of the 1928 activities and predicted another active year for the club in its studies and discussions of foundry problems.

Dr. Evans, the newly elected president of the club, received his technical training at the University of Kansas and Iowa State college, being awarded the degree of doctor of philosophy at the latter institution in 1925. He was metallurgist for the American Smelting & Refining Co. and later was on the faculty of the Kansas State Teachers' college and the Iowa State college, resigning the latter connection to become metallurgist for the Pettibone Mulliken Co. He is a member of the American Foundrymen's association, American Society for Steel Treating and the American Society for Testing Materials and has contributed papers and articles to the technical press.

Absorbs Gear Company

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has taken over the assets of the R. D. Nuttall Co., Pittsburgh. The Nuttall company will be operated as a branch of the Westinghouse company and its plant will be known as the Nuttall works of the Westinghouse Electric & Mfg. Co.

Obituary

Samuel Wylie Miller, 62, international authority on welding and consulting engineer since 1921, of the Union Carbide & Carbon Research Laboratories, Long Island City, N. Y., died Feb. 3 at his home in Hollis, L. I. Mr. Miller was a native of New York City and received a degree in mechanical engineering from the Stevens Institute of Technology in 1887. He was credited with having been among the first members of his profession to visualize the possibilities of oxyacetylene welding and he did much to develop and apply this process in a practical way. He wrote several books on welding and spoke on different phases of the art of welding at numerous conventions of technical organizations. He was past president, member and director of the American Welding society and held memberships in the following technical bodies: American Society for Testing Materials, the American Society of Mechanical Engineers, the American Society for Steel Treating, the American Iron and Steel institute, Master Boilermakers' association, the Iron and Steel institute in Great Britain, the Institute of Metals and the Institution of Welding Engineers. Mr. Miller was the donor of the Miller gold medal, established by him early in 1927 and which is awarded annually by the American Welding society in appreciation of work of outstanding merit in advancing the art and science of welding.

Frederick L. Sivyer Dies in Auto Accident

Frederick L. Sivyer, 49, president of the Sivyer Steel Casting Co., Milwaukee, and vice president of the Rockford-Northwestern Malleable Iron Co., Milwaukee and Rockford, Ill., whose death was announced in the Feb. 1 issue of THE FOUNDRY, died Jan. 22, as a result of injuries sustained when he was pinned between a stalled car and one which had skidded. Mr. Sivyer was a leader in the malleable iron and steel casting industry, and was president of the Malleable Iron Research institute, Cleveland. He was born in Milwaukee, Dec. 23, 1879. His father, the late Frederick W. Sivyer, three years earlier had established Elmore, Sivyer & Co., the name later being changed to the Northwestern Malleable Iron Co., and as a boy Frederick L. Sivyer spent much time in and about the shop. After his preliminary education in the public and high schools of Milwaukee, he attended Cornell university for two years. He then entered his father's shop as a molder to learn the fundamentals of the business. He gained experience in the various departments and in 1902 was elected secretary and superintendent. Four years later he was elected vice president to succeed W. A. Draves, deceased. In 1910,

FREDERICK L. SIVYER

following the death of his father, he became president. When the company was merged with the Rockford Malleable Iron Co., he was made vice president. In 1909, he had organized the Sivyer Steel Casting Co., and was its president.

During the war Mr. Sivyer assisted Herbert F. Perkins, president, International Harvester Co., in munitions work. He later was placed in charge of semi-steel shell production, donating his services to the government.

Is Elected Chairman

Andrew Wells Robertson, Pittsburgh, has been elected chairman of the board of directors of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Robertson is a native of Scotland and is 49 years of age. He was graduated from Allegheny college, Meadville, Pa., in 1906 and with an A.B. degree and from the law school of the University of Pittsburgh in 1910 with an L.L.D. degree. Following graduation he practiced law in Pittsburgh and became general attorney of the Philadelphia Co., Pittsburgh. He was elected to a vice presidency in the company and in 1926 was elected president. Mr. Robertson will withdraw from his other business activities and devote his entire time to the Westinghouse Co.

Gives Program

(*Concluded from Page* 58)

same time economize on the amount of metal required to fill them.

Four interesting papers and reports are scheduled for the malleable iron foundry session at 10 a.m., Thursday. Report of the representative on committee advisory to the bureau of standards will be presented by J. B. Deisher, Rochester, N. Y. The report of the chairman of the division of malleable iron foundry practice also will be presented at this session. Points brought up at this session and others developed later will be discussed at a round table luncheon to be held at 12:30 p.m.

Report of the committee on apprentice training Thursday at 10 a.m., will be followed by two papers dealing with specific phases of apprentice training activities in two prominent plants, one in Philadelphia and the other in Chicago.

A symposium on high test iron from an American and a European standpoint will be presented at a 2 p.m. session Thursday. Contributors to this important subject include Dr. E. E. Marbaker, Mellon institute, Pittsburgh, Dr. Fritz Meyer, National Radiator Co., Johnstown, Pa., F. B. Coyle, International Nickel Co., New York City, R. S. McCaffery, department of metallurgy, University of Wisconsin, Madison, Wis., R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee, H. Bornstein, Deere & Co., Moline, Ill.

Two sessions are booked for 4 p.m., Thursday. One is concerned with the gray iron foundry shop operating course and will be considered under the twin heading: "Cupola Control-Melting Operations." The second session, part of the steel foundry shop operation course will deal with heat treatment of steel castings.

The Magnetic Mfg. Co., Milwaukee, recently incorporated the name Stearns with the trade name which has been carried on its line of products. The new designation is derived from the names of the company officers, R. H. Stearns being president and treasurer and R. N. Stearns secretary.

Wilson Foundry Reaches Production Peak

Wilson Foundry & Machine Co., Pontiac, Mich., experienced the greatest year in its history during 1928, according to David R. Wilson, vice president and general manager. The company produced over 300,000 units for engines for the Willys-Overland Co. in the past year and expects to exceed 400,000 units this year. The average employment of the company was 3700 in 1928 as compared with 3500 for 1927.

Furnace Manufacturers Form Association

Surface Combustion Co., 2375 Dorr street, Toledo, O., Rust Engineering Co., The American Bank building, Pittsburgh, Holcroft & Co., Book building, Detroit, Chapman-Stein Co., Mt. Vernon, O., Costello Engineering Co., 519 Oliver building, Pittsburgh, George J. Hagen Co., Chamber of Commerce building, Pittsburgh, William Swindell & Bros. Co., Pittsburgh, and W. S. Rockwell Co., New York, manufacturers of combustion furnaces, have formed a new industrial association to be known as the Industrial Furnace Manufacturers association. Officers of the new association are: F. Manker, Surface Combustion Co., president; C. F. Cone, George J. Hagen Co., secretary and treasurer.

New Brick Company Elects Officers

John D. Ramsay, Elk Fire Brick Co., St. Marys, Pa., has been named president of the North American Refractories Co., an organization recently formed to consolidate six manufacturers of fire brick and refractory material. Main offices of the company will be located in Cleveland. The companies involved in the merger are: Ashland Fire Brick Co., Ashland, Ky.; Crescent Refractories Co., Curwensville, Pa.; Dover Fire Brick Co., Cleveland; Elk Fire Brick Co., St. Marys, Pa.; Farber Fire Brick Co., Farber, Mo.; Queen's Run Refractories Co. Inc., Lock Haven, Pa.

Six vice presidents have been named as follows: J. M. McKinley, Curwensville; Harry Sleicher, Lock Haven; John Cavender, Cleveland; E. M. Weinfurtner, Ashland; E. H. Gartrell, Ashland; H. E. Stuhler, Cleveland, has been named treasurer.

No change will be made in personnel at the various plants, and operations will continue as before for the present. The company has 15 plants, with an annual capacity of 155,000,000 brick.

Subscribes to Index

The Cleveland Public library has subscribed to the Engineering Index service containing a concise digest of articles appearing in over 1700 leading American and foreign technical periodicals. The notations received under this service and made available through the Cleveland library include engineering activities of the following classifications: Mechanical, civil, electrical, chemical, mining, metallurgical, management, naval, architectural, railroads and aeronautics. G. O. Ward, head of the division of science and technology, is in charge.

Is Appointed Manager

H. A. Baker, Schenectady, N. Y., has been appointed service manager of the International General Electric Co., with headquarters in New York City. Mr. Baker succeeds C. F. Neave, recently named manager of the newly organized refrigeration department of the company.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Cockshutt Plow Co., Brantford, Ont., contemplates the erection of extensions to its plant.

Youngstown Pattern Co., Youngstown, O., suffered a slight damage by fire recently. A. W. Carver is president.

Vulcan Iron Works, New Britain, Conn., suffered $2000 damage by fire recently.

Dissolution of the Williams Foundry & Machine Co., Akron, O., was sought in Common Pleas court recently.

Anderson Stove Co., Anderson, Ind., reports business good and that it is operating at capacity.

Directors of the American Radiator Co have approved the acquisition of the Standard Sanitary Mfg. Co., Pittsburgh.

Texas Electric Steel Castings Co., Houston, Tex., has increased capital from $75,000 to $150,000 to take care of expansions.

Farrell-Cheek Steel Foundry Co., Sandusky, O., is doubling production facilities for its special wearing alloy steel castings.

Southern Signal Co., 2017 Portland avenue, Louisville, Ky., suffered damage to its plant in a recent fire.

National Malleable & Steel Castings Co., 1400 South Fifty-second avenue, Cicero, Ill., plans the construction of a 1-story plant, 80 x 101 feet.

The output of the new Delco-Remy foundry, plant 5, Anderson, Ind., gradually is increasing. The plant is in the experimental stage but production will be increased to capacity in the near future. (Noted Nov. 1.)

National Malleable & Steel Castings Co., Cleveland, has sold to the Lanzit Corrugated Box Co., Chicago, a tract 189 x 279 feet at Twenty-fourth and Rockwell streets, Chicago.

Apex Pattern & Foundry Co., 5814 South Wood street, Chicago, has been incorporated with $15,000 capital to manufacture and deal in castings, household wares, etc., by C. P. Stake.

An order has been signed directing sale of the assets of the Marr Bronze Foundry Inc., Buffalo. The assets have been assigned to Roland H. Tills for the benefit of creditors.

Marshall Furnace Co., West Hanover street, Marshall, Mich., is planning a one-story addition which including equipment will cost about $40,000. (Noted Jan. 1.)

East Penn Foundry Co., Macungie, Pa., has begun its expansion program to include new one-story units and additional equipment to cost more than $40,000.

J. B. Klein Iron & Foundry Co., Oklahoma City, Okla., soon will begin the construction of a one-story foundry and machine shop unit at St. Louis to cost about $60,000.

Wheatley Bros. Brass & Metal Works, Tulsa, Okla., has acquired a 2-acre site on Sand Springs road for a new plant including shop and office building.

Evansville Malleable Castings Co., Evansville, Ind., 2549 East Colm street, L. P. Edwards, manager, plans the construction of a plant tem for the handling of materials.

Wilson Foundry & Machine Co., Pontiac, Mich., is making an addition to its foundry building for the installation of a conveyor system.

General Steel Castings Co. is the name adopted for the steel foundry being built by American Steel Foundries, American Locomotive Co. and Baldwin Locomotive Works adjoining the latter's plant at Eddystone, Pa. (Noted Jan. 15.)

Kupfer Foundry & Iron Co., Madison, Wis., has been incorporated as the Theo. Kupfer Foundry & Iron Works Inc., with authorized capital of $100,000. Principals are Theodore Kupfer Jr. and J. J. Gerhardt.

Shilling Foundry Co., Columbus, O., manufacturer of stoves, manholes, catch basins and similar products, has built an addition to its plant. J. S. Porter has been made general manager.

Alloy Cast Steel Co., Marion, O., has let contracts for increasing its floor space 50 per cent and the purchase of an additional melting unit. The new equipment practically will double the plant capacity.

Bryant Pattern & Mfg. Co., 201 Glengarry avenue, Windsor, Ont., has awarded the contract for the erection of a machine and pattern shop, 90 x 96 feet, to W. Price, Pelissier

street,, Windsor, Ont., Canada.

Landis Machine Co., Waynesboro, Pa., I. G. Benedict, manager, plans the construction of a top addition to its manufacturing plant. J. Klinkhart, 54 West Washington street, Hagerstown, Md., is architect.

Phoenix Brass Fittings Corp., Irvington, N. J., has been organized to succeed the Phoenix Brass Foundry. The new corporation expects to improve plant facilities and add to its lines of brass products. No new buildings are contemplated.

Turner Engineering Corp., Worcester, Mass., has been incorporated with 500 shares no par value stock to engage in the engineering and construction business, and to operate a foundry, machine shop, etc., by Albert Turner, Shrewsbury, Mass.

East St. Louis Casting Co., Sixteenth and Kansas streets, East St. Louis, Ill., has awarded a general contract to Fruin-Colnon Contracting Co. for a one-story foundry, 110 x 240 feet, which, including equipment will cost over $85,000.

Oklahoma Structural Steel Co., 115 North Harvey street, Oklahoma City, Okla., will complete plans in about 30 days for a new plant in the South Agnew district. Several buildings are contemplated among them a one-story foundry, 60 x 100 feet.

Dominion Wheel & Foundries Ltd., Toronto and Winnipeg, will exercise its option taken several weeks ago on 8 acres of city owned land at Calgary, Alta., adjacent to the Manitoba Rolling Mills Ltd., and will erect a new plant.

The New York Car Wheel Co., Buffalo, maker of railroad car wheels, has purchased the Brown Car Wheel Works, also of Buffalo. It is planned to operate the Brown plant for a time after which it will be turned into a storage plant for the New York company.

Eljer Co., Ford City, Pa., maker of sanitary ware, has purchased the plant and business of the National Sanitary Co., Salem, O. The Salem plant will continue to operate as a branch. The company also is planning an expansion program.

Conshohocken Foundry Co., Conshohocken, Pa., recently organized by David Baker Jr., Rosemont, Pa., and associates with a capital of $50,000, plans the operation of a local plant to manufacture iron, steel and other metal castings.

Gross sales of the Pettibone Mulliken Co. in November and December, 1928, amounted to $617,245, with net income for the period of $88,050. The company is successor to the organization of the same name whose assets it purchased.

Lakey Foundry & Machine Co., Muskegon, Mich., subsidiary of Continental Motor Co., has been awarded a large order for castings from the Ford Motor Co., consisting of 300 to 400 motor blocks daily for the remainder of this year, as well as for other parts. The motor blocks are for the old model T car as replacement parts.

Johnson Bronze Co., New Castle, Pa., has let the contract for two 2-story additions, 85 x 150 feet and another 120 x 160 feet, to Hawkins Dowie Co., Youngstown, O. The new buildings and equipment will cost $85,000. A part of the addition will be used as a foundry unit. (Noted Feb. 1.)

Negotiations are under way by the Bessemer Gas Engine Co., Grove City, Pa., and the C. & G. Cooper Co., Mt. Vernon, O., both manufacturers of gas engines, that are expected to result in a consolidation of the two companies. Definite announcement regarding the merger is to be made shortly. No change is anticipated in personnel of the two organizations and operations will be continued at both plants.

Bethlehem Foundry & Machine Co., Bethlehem, Pa., recently elected the following officers of the company: W. A. Wilbur, chairman of the board of directors; J. George Lehman, president; Robert E. Wilbur, first vice president; G. Ernest Finck, treasurer and I. E. Krause, secretary.

United States Foundry Co., Los Angeles, has been organized by H. F. Long and has leased the plant of the Holbrook, Merrill & Stetson Foundry, 6917 McKinley avenue. The new company will make gray iron castings specializing in stove and heater work. They also will manufacture aluminum castings and sanitary ware.

Canadian Compression Joints Ltd., Vancouver, B. C., has been incorporated to manufacture and deal in metal and metal products, and to carry on the business as founder, with $150,000 capital and 300,000 shares no par value stock by Joseph C. Boyes, Louis G. Scott, Gordon W. Scott and others, all of Vancouver.

Birmingham Machine & Foundry Co. and Joubert & Goslin Machine & Foundry Co., Birmingham, Ala., have been merged, with W. H. Hassenger president of the board, Julius Goslin president, and George M. Morrow Jr. vice president and general manager. Offices of the president will be maintained in New York.

The J. B. Ripley Brass Foundry Inc., Windsor, Vt., recently has acquired 4 acres of land adjoining the Central Vermont railroad, and soon will build a new foundry building. It will be 40 x 140 feet and will have the latest equipment for the manufacture of nonferrous castings.

Summit Brass & Bronze Co., Akron, O., and the Newton Foundry Co., Barberton, O., have been consolidated into the Summit-Newton Foundry Co., located at 241 East State street, Barberton, O. The firm is equipped to manufacture iron, semisteel, brass, bronze and aluminum castings. It also will make patterns. John Zamarik is president of the company, John Donald, vice president, John Metzler, secretary and John Binns, treasurer.

The General Bronze Co., Pittsburgh, has purchased additional property adjoining its plant at Smallman and Thirty-second streets for enlarging its foundry capacity. This frontage lies between the original plant and a new two-story building completed in April, 1928, which recently was purchased by the General company. Construction is planned to combine the two buildings into one structure. New equipment for the foundry addition, which will accommodate core making and furnace equipment, has been ordered.

Llewellyn Iron Works, Baker Iron Works, and Union Iron Works, all of Los Angeles, have been combined to form the Consolidated Steel Corp., Los Angeles. The officers of the new company are Lee A. Phillips, chairman of the board of directors; Waller Taylor, president; Reese Llewellyn, chairman of the executive committee; Ford J. Twaits, executive vice president; Milton Baruch, Harry S. Hitchcock, and Robert Miller, vice presidents; Lynd C. Rollins, secretary and O. Rey Rule, treasurer. (Noted Jan. 14.)

Monarch Aluminum Ware Co., 4613 Payne avenue, Cleveland, has acquired 100,000 square feet of floor space in the Power Warehousing Terminal building, West Ninety-fourth street and Detroit avenue and the manufacturing facilities of the Club Aluminum Ware Co. now located at Baltimore and Chicago. These plants will be consolidated at the new Cleveland plant. The Monarch company will specialize in the manufacture of permanent mold castings and also will operate a sand foundry. Polishing and assembling departments will be installed.

New Trade Publications

MONORAIL SYSTEMS—The Louden Machinery Co., Fairfield, Iowa, has issued a bulletin giving the uses of the new monorail system which it manufactures.

PORTABLE DRILLS—The Stow Mfg. Co., Bradford, Pa., has issued a folder describing and illustrating the various types of portable drills that the company makes. Tables give dimensions and other information concerning these tools.

BOILERS—Erie City Iron Works, Erie, Pa., is circulating a booklet on its powdered coal fired return tubular boilers. The theory underlying the construction of the furnace and its advantages are given. Several illustrations show various views of an illustration. Sketches illustrate the methods used to convey coal to pulverizers both for a single setting and for a battery setting.

PORTABLE PARTITIONS—Hyde-Murphy Co., Ridgway, Pa., recently has issued a 32-page booklet on its portable partitions. The booklet describes and illustrates the various uses of this product, gives plans for offices, and illustrates by sketches the outstanding advantages of the partitions. Specifications also are discussed. The booklet contains illustrations from photographs of typical installations.

VENTILATION—Detroit Steel Products Co., 2250 East Grand boulevard, Detroit, recently published an 11-page folder on lighting and ventilation. The folder tells the advantages of adequate daylighting and airation and describes with the aid of sketches the methods used to secure these features. The folder contains illustrations from photographs of typical installations and also describes the research laboratory of the company.

CHEMICALS—National Scientific Corp., 814 Franklin avenue, Chicago, recently has published a catalog of clinical and laboratory supplies. The catalog illustrates many pieces of apparatus and prices are quoted. It also contains illustrations of several types of microscopes and accessories. A section is devoted to laboratory furniture. The back of the catalog contains a price list of many chemicals, stains, indicators and solutions.

FURNACES—Carborundum Co., Niagara Falls, N. Y., and the Erie City Iron Works, Erie, Pa., have co-operated in publishing an 8-page booklet on a boiler installation made by the Erie company using refractories supplied by the Carborundum Co. Its design and advantages are described and several views, outside and inside, show the construction of the furnace and the refractory in service.

COMPRESSORS—Ingersoll-Rand Co., 11 Broadway, New York, recently has published a bulletin covering its new gas-engine-driven compressor. It consists of a 2-cylinder, 4-cycle gas engine direct connected to the company's compressing cylinders which are equipped with plate-type valves. The bulletin describes and illustrates the various parts of the compressor and contains many sectional views of the machine. It also contains numerous illustrations of typical installations.

COMPRESSORS—Worthington Pump & Machinery Corp., 2 Park avenue, New York, recently has issued a bulletin on its vertical, feather-valve compressors. This bulletin is novel in that it takes the various parts of the machine and describes them and explains their workings in the form of questions and answers. The booklet is illustrated with sectional views of many of the parts of the pump and with sketches of the pressure regulator arrangement and the automatic start and stop layout. A table gives the specifications of the various size units.